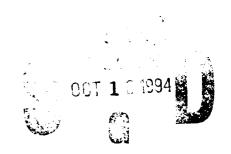
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### DEVELOPMENT OF AN ADVANCED JP-8 FUEL



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Technical effort was directed at increasing the design limit of current JP-8 fuel from 325F (163C) to 425F (218C) at the fuel nozzle. The objective was to accomplish this near-term thermal stability goal solely through the use of a fuel soluble additive package. JP-Thermally stable fuel was considered the thermal stability target since it has the high-temperature properties sought from the significantly more economical JP-8 + 100 formulation. The additives were evaluated in an additive-free Jet A considered typical of fuel most tikely encountered in the field. DuPont JFA-5, currently the only accepted thermal stability improving additive, was considered state of the art and used as a bench mark. Additive manufacturers were surveyed and solicited for candidate additives that had potential for improving fuel thermal oxidative stability. Test methods were developed and/or refined for use in screening additives. Using the Hot Liquid Process Simulator (HLPS) in conjunction with a LECO Carbon Determinator, 152 additives were screened. Additive performance was ranked based on surface carbon and differential pressure. Additional screening was performed using the Isothermal Corrosion Oxidation Test (ICOT). The additives screened included oxygen, sulfur, and nitrogen-type antioxidants; dispersants; detergents; metal deactivators; antifoulants; and proprietary thermal stability improvers. Twenty-seven experimental blends comprised of various additive combinations were tested. Five baseline fuels were evaluated. These fuels included POSF 2827 Jet A reference fuel, POSF 2799 JP-Thermally Stable, POSF 2747 Super K-1 kereosene, POSF 2926 Shell Oil Jet A, and POSF 2928 Exxon Jet A with 15% hydrocracked stock. POSF 2827 represented a typical Jet A and was the primary reference fuel in which the additive candidates were blended and evaluated. A number of special investigations were also performed. A detergent/dispersant was identified that approached the thermal stability target. Future work will be directed at formulating and optimizing a package comprised of a detergent/dispersant, an antioxidant, and a metal deactivator.

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### PREFACE AND ACKNOWLEDGMENTS

This final report describes the technical effort conducted under Air Force Contract No. F33615-90-C-2051, entitled "Development of An Advanced JP-8 Fuel." The technical effort described herein was conducted over a period from August 1990 through January 1993. The research conducted under this contract was administered under the direction of Mr. Steven Anderson, WL/POSF Project Scientist, and Tedd Biddle, P&W Program Manager.

The research conducted under this program was the product of many contributors. Among those who provided guidance and practical experience in pursuit of the program objectives were Steven Anderson, Mel Roquemore, William Harrison, Timothy Edwards, and Robert Morris of WL/POSF. The P&W team which acted as a liaison with the additive manufacturers, compiled the candidate additive inventory, performed screening tests, test method development, and considered the affects of a high-temperature fuel on fuel system components included Tedd Biddle, William Edwards, Earl Hamilton, Toni Massar, Mike Polito, and Richard Sullivan of the P&W Fuels and Lubricants Laboratory; Matt Eder of the F119 Controls Group; and Charlie Graves of the F119 Combustor and Augmentor Group; and Andy Brankovic of the CFD Modeling Group.

Contributors from the University of Dayton Research Institute included Robert Kauffman, Vish Katta, Steven Zabarnic, and Shawn Heneghan. In addition, technical support was provided by Ted Williams, Ed Bins, and Chuck Martel of Systems Research laboratory. Support directed at implementing the Quartz Crystal Microbalance at P&W for monitoring fuel deposition rates in real time was provided by Elmer Klavetter, Steven Martin, and Leonard Casaus of Sandia National Laboratory. The aforementioned organizations and personnel were instrumental in the successful completion of this program. The diverse mix of disciplines, expertise, and experience provided considerable insight into reaction mechanisms and kinetics of deposit formation, CFD modeling, test method development, additive chemistry, and implementation of experimental approaches for determining the propensity of fuels and additives to oxidize and to form deposits and bulk fuel insolubles in static and flowing systems.

### 1.0 SUMMARY

Technical effort was directed at increasing the design limit of current JP-8 fuel from 325°F (163°C) to 425°F (218°C) at the fuel nozzle. The objective was to accomplish this near-term thermal stability goal solely through the use of a fuel soluble additive package. JP-Thermally stable fuel was considered the thermal stability target since it has the high-temperature properties sought from the significantly more economical JP-8 + 100 formulation. The additives were evaluated in an additive-free Jet A considered typical of fuel most likely to be encountered in the field. DuPont JFA-5, currently the only accepted thermally stability improving additive, was considered state of the art and used as a bench mark.

Additive manufacturers were surveyed and solicited for candidate additives that had potential for improving fuel thermal oxidative stability. Test methods were developed and/or refined for use in screening additives. Using the Hot Liquid Process Simulator (HLPS) in conjunction with a LECO Carbon Determinator, 152 additives were screened. Additive performance was ranked based on surface carbon and differential pressure. Additional screening was performed using the Isothermal Corrosion Oxidation Test (ICOT).

Additives screened included oxygen, sulfur, and nitrogen-type antioxidants; dispersants; detergents; metal deactivators; antifoulants; and proprietary thermal stability improvers. Twenty-seven experimental blends comprised of various additive combinations were tested. Five baseline fuels were evaluated. These fuels included POSF 2827 Jet A reference fuel, POSF 2799 JP-Thermally Stable, POSF 2747 Super K-1 kerosene, POSF 2926 Shell Oil Jet A, and POSF 2928 Exxon Jet A with 15% hydrocracked stock. POSF 2827 represented a typical Jet A and was the primary reference fuel in which the additive candidates were blended and evaluated. A number of special investigations were also performed. A detergent/dispersant was identified that approached the thermal stability target.

### 2.0 INTRODUCTION

Fuel thermal stability has been recognized as a critical limiting factor in the design of advanced engines. Increased heat loads resulting from increases in lubricant and hydraulic fluid operating temperatures and extensive airframe electronics will rely on the cooling capabilities of the fuel. To accommodate these heat loads, engine hardware designers and fuel developers are confronted with developing coke resistant hardware in combination with fuels with greater cooling capacities. Unless more thermally stable fuels are developed, the benefits of programs such as the Integrated High Performance Turbine Engine Technology (IHPTET) initiative will be partially offset by the need for larger recirculating systems to maintain fuel temperatures below their thermal stability limits. Development of high temperature fuels will rely on the availability of precise, analytical tools for characterizing the thermal stability properties of jet fuels and to accurately model the thermal deposition process:

This program focused on the development and demonstration of innovative laboratory-scale techniques, and use of these techniques in the formulation of a near-term advanced JP-8 fuel. The program was directed specifically at development of an advanced JP-8 fuel to meet or exceed near-term fuel thermal oxidative stability goals. Near-term high temperature stability requirements have been identified by Wright Laboratory (WL) as an increase in fuel temperature at the nozzle from 325° to 425°F (163 to 218°C). This has been described in fuel development terms as JP-8 + 100°F fuel. As a prerequisite to JP-8 + 100°F development, unique and innovative laboratory techniques are required for use in screening, evaluation, and study of candidate fuel/additive formulations. The analytical methodologies developed under this program focused on quantification of fuel deposits and compositional changes of candidate fuel formulations under thermal stress.

Program goals were pursued under four interrelated tasks:

- Task I Development of Techniques For Screening and Evaluating Additives
- Task II Procurement and Blending of Fuel/Additive Formulations
- Task III Screening and Evaluation of Candidate Additives
- Task IV Characterization of Formu-lations Meeting JP-8 + 100°F Criteria

### 3.0 RESULTS AND DISCUSSION

### Task I - Development of Techniques For Screening and Evaluating Additives

Task I was directed at development, refinement and implementation of new test methods for screening candidate additive formulations and, ultimately, for characterizing the temperature capabilities of an advanced JP-8 fuel meeting the requirements of JP-8 + 100 °F.

Four test methods were developed and evaluated, or existing methods refined, for use in screening additives and baseline fuels. These included the Microthermal Precipitation Test (MTP), Fuel Reactor Test, Hot Liquid Process Simulator (HLPS), and Isothermal Corrosion Oxidation Test (ICOT).

### • Microthermal Precipitation Test

The impetus for this development effort was the need for a screening test that could discriminate between fuels of varying propensity to produce thermally induced insoluble particulate material in the bulk fuel. The Microthermal Precipitation (MTP) test thermally stresses a 500-milliliter (mL) fuel sample at 300°F (149°C) for three hours. Fuel pretreatment includes a 6-minute air sparge. A constant oxygen supply to the fuel is maintained by way of 200 psig air pressurization. The fuel is continuously stirred throughout the test. Test temperature is based on fuel temperature as opposed to skin temperature.

At the conclusion of the test, three 50-mL and three 100-mL aliquots of the fuel are filtered through an in-line 25-millimeter (mm) Gelman glass filter having a 1-micron nominal pore size. Particulate material suspended in each aliquot is captured on a Gelman glass filter and quantified via carbon burnoff using a LECO RC-412 Carbon Determinator. Results are reported as micrograms of carbon per square centimeter (µg/cm<sup>2</sup>).

### Test Set Up

The MTP test is a stand-alone system which incorporates a JFTOT fuel reservoir; an aluminum heating mantel; controlling thermocouple; temperature controller; sampling, bypass and purging valves; and a sampling port with an in-line filter for filtering and collecting the sample. A detailed description of the equipment setup is presented in the following paragraphs.

### System Pressurization

The fuel reservoir is pressurized with compressed air. Both a pressure relief and an overpressure safety valve are positioned at the top of the reservoir. The overpressure valve was added for safety in case of sudden pressure spikes due to regulator failure or auto ignition. In addition, a shutoff valve isolates the regulator and gauges from the

pressurized fuel reservoir during testing. This safeguards against regulator damage in the event of autoignition. A condensing coil is located between the reservoir and pressure gauge to keep condensing vapors from damaging the gauge mechanism.

### Heating And Temperature Control

An aluminum heating mantel and temperature controller unit was custom fabricated by InterAv, Inc. The InterAv power supply and enclosure uses an Omega Series 4000A proportional controller. The accuracy of this controller is +/- 0.5% full scale and has a 1°F resolution. To improve temperature stability and reduce heat loss, a zirconium (Zr) wool jacket is placed around the heating mantel.

A temperature controlling thermocouple, inserted through the top of the reservoir cover then lowered, mid-point into sample, is used to control fuel temperature. A calibrated type K chromel/alumel thermocouple is used. A stir plate and stir bar is used to ensure uniform temperature throughout the sample.

### Filtering and Collection of Sample

A sample collection port is located at the bottom of the fuel reservoir. Sampling is controlled by two valves. A stainless steel, three-way valve directs the sample through a vernier flow control valve to the filter holder, through the Gelman glass filter, and into a graduated cylinder. Placed in the alternate position, the three-way valve reroutes the sample through a stainless steel tube into a collection beaker. In this second valve position, a nonfiltered sample can be obtained or the reservoir drained.

Filtering is accomplished using a 25-mm Gelman borosilicate glass microfiber filter. The Gelman filters used are type A/E containing no organic binders and are autoclavable. The filters are rated at 1022°F (550°C) and have a 1-micron nominal pore size. Lot numbers are maintained for each analysis. The Gelman glass filter is housed in a Millipore micro-syringe 25-mm filter holder which has been modified with a Swagelok fitting. The filter holder is 304 stainless steel. Filtering rate is governed via the vernier valve which is located downstream of the filter holder. In addition, a vernier valve is positioned in line with a vacuum pump to ensure a constant, uniform vacuum rate during the hexane rinse of each filter.

### Results

Preliminary test results showed that the MTP had the ability to discriminate between fuels and additives of varying propensity to form bulk fuel insolubles. Appendix B presents a ranking of additives based on the MTP test as well as a master list of all replicate runs performed. The MTP test was ultimately replaced by the Fuel Reactor test due to a requirement to accelerate additive screening. The Fuel Reactor Test is described in the following section.

### • Fuel Reactor Test

The Fuel Reactor Test was developed to be less labor intensive than the MTP test and permit testing up to four additives simultaneously. Test conditions are similar to those established for the larger-scale MTP test:

- √ Fuel preparation: prefiltered through a 10µ-Millipore filter; 6-minute sparge
- √ Sample size: 60 milliliter (mL)
- √ Reactor vessel: 75-mL Pyrex glass test tube inserted in a 9 inch X 1<sup>1</sup>/<sub>4</sub> inch O.D. stainless steel bomb
- √ Thermal stressing: four-port COS aluminum block heater; 300°F (149°C) for 3 hours; 200 psig air
- $\sqrt{No. of tests per series}$ : four tests performed simultaneously

At the conclusion of the test, the stressed fuel from each bomb is filtered through a 1-micron Gelman glass filter. The filters are analyzed for surface carbon using a LECO RC-412 Carbon Determinator.

Five Fuel Reactors were fabricated. The fuel reactors were basically 9-inch X 1<sup>1</sup>/<sub>4</sub> inch O.D. stainless steel bombs. A two-way valve is used to introduce the desired atmosphere and pressure. Swage-type fittings allow disassembly for cleaning the reactor and loading the test fuel. A 75-milliliter (mL) Pyrex glass test tube is used to prevent contact of the fuel and minimize contact of its vapor with the metal reactor walls. Four reactors can be thermally stressed simultaneously using a four-port Corrosion Oxidation Stability (COS) aluminum-block heater. Optimum test times, temperatures and pressures were determined.

The Fuel Reactor test provides a number of advantages over that of the MTP test. These include smaller sample size, post test filtering of the entire aliquot thermally stressed, less labor intensive and performance of up to four tests simultaneously. Preliminary testing showed that the Fuel Reactor test ranked fuels of varying propensity for thermal precipitation in the same order as the MTP test. Repeatability and discrimination between fuels was as good or better than the MTP test. Appendix C presents a ranking of additives based on the Fuel Reactor test as well as a master list of all replicate runs performed.

### • Hot Liquid Process Simulator Test

The Hot Liquid Process Simulator (HLPS) was selected as the primary tool for screening additives. A detailed description of the technique and how it was applied in screening candidate thermal stability improving additives is described in "Task III - Screening and Evaluation of Candidate Additives." Further, Task III presents a comprehensive ranking of all reference fuels, additives, and experimental blends based on HLPS test results.

### • Isothermal Corrosion Oxidation Test

The Isothermal Corrosion Oxidation Test (ICOT) was developed by WL for use in screening additives. Because of its ease of setup and quickly established database at WL, it was implemented at P&W as a tool for monitoring bulk fuel insolubles produced during thermal stressing of fuel/additive formulations. A detailed description of the technique and how it was applied in screening candidate thermal stability improving additives is described in "Task III - Screening and Evaluation of Candidate Additives." Further, Task III presents a comprehensive ranking of all reference fuels, additives, and experimental blends.

### • Quartz Crystal Microbalance

A Quartz Crystal Microbalance (QCM) developed by Sandia National Laboratories (SNL) demonstrated the ability to monitor deposition rate in real time in a static reactor vessel. As a result of technical discussions at WL and SNL, a QCM was evaluated at P&W and University of Dayton Research Institute (UDRI) for use in screening additives. P&W teamed with SNL and UDRI in test method development for static applications.

Preliminary testing showed the technique to be very promising. The test appears to lend itself to routine analysis. An investigation was conducted directed at evaluating the affect of time, temperature, and atmosphere on test repeatability and differentiation between fuel types and additives. The test has been implemented for use in evaluating additives.

### Task II - Procurement and Blending of Fuel/Additive Formulations

One hundred fifty two additives were received from 19 additive manufacturers and distributors for screening. A current inventory showing additive category, manufacturer, blending concentration and chemical description is included in Appendix A at the end of this report.

### Task III - Screening and Evaluation of Candidate Additives

### • Hot Liquid Process Simulator Test

All additives in inventory were screened using the HLPS. A comprehensive HLPS ranking of the reference fuels and additives evaluated is shown in Table 2-1. Figure 2-1 is a graphical representation of the HLPS ranking for the 50 h st performing reference fuels and additives. Ranking of the reference fuels and candidate additives is based on surface carbon produced during a 5-hour HLPS test performed at 635°F (335°C) using a 316 series stainless steel JFTOT tube. Where multiple tests were performed, the value shown

is an average of the replicate runs. Appendices A through C present master lists of all replicate HLPS, ICOT, MTP, and Fuel Reactor tests performed.

An "Index of Merit" was applied to the additives evaluated in the HLPS test. The formula was used to identify the most promising additives. These additives will be considered for advancement to a second level of screening. Secondary screening will subject the additives to screening in several fuels, package reformulation and concentration optimization, then onward to larger scale flowing tests such as the Phoenix Rig, Augmentor Rig, and the Extended Duration Test. The Index of Merit considers the baseline fuel in which the additive was evaluated and performance in relation to the JP-TS target. Considered for secondary screening are those additives which show a carbon reduction ≥ DuPont JFA-5. JFA-5 is the only thermal stability improving additive approved by military specification. Currently, it is considered state of the art.

### • Isothermal Corrosion Oxidation Test

In the Isothermal Corrosion Oxi-dation Test (ICOT), performance of the reference fuels and candidate additives is based on carbon produced during a 5-hour test performed at 356°F (180°C). A 70-mL aliquot of fuel is stressed in a 38-millimeter (mm) OD X 300-mm glass COS tube using a multiport aluminum block heater. A 0.25-inch O.D. X 30-inch glass blower tube bubbles air into the fuel at a rate of 1L/hour. Condenser temperature is 68°F (20°C). At the conclusion of the test, the entire aliquot of fuel is filtered through a 1-micron Gelman glass filter. The blower tube and the filter are rinsed with hexane. The filter is dried in an oven prior to carbon burnoff. A LECO RC-412 Carbon Determinator is used to measure surface carbon formed on the glass blower tube and bulk fuel insolubles collected on the Gelman glass filter.

ICOT were performed on 21 additives. Each additive was tested in duplicate. Priority was placed on testing those additives shown to be most promising in HLPS tests.

Reference and target fuels, along with additives screened to date, are ranked in Table 2-2. These are shown in order of increasing bulk fuel insolubles. Blower tube surface carbon is also shown. The value shown is an average of two to four runs. Appendix A presents a master list of all replicate ICOT tests. Standard deviation and coefficient of variation is included for some tests to give insight into the repeatability exhibited by the ICOT. Statistical analysis shows that the ICOT should be considered as a "ball park" screening test.

TABLE 2-1
HLPS RANKING OF FUELS, ADDITIVES, AND EXPERIMENTAL BLENDS

Product Name	Carbon (µg/cm <sup>2</sup> )	Delta P/Time (mm Hg/min.)	Product Name	Carbon (µg/cm <sup>2</sup> )	Delta P/Time (mm Hg/min.
Exxon JP-TS	3		POSF 2942	41	300/240
JP-TS Non-Add. Sp. Blend	5 5	4/300	POSF 2786, 11 mg/L	44	0/300
AF JP-TS	6	1/300	POSF 2786 + 2856	44 44	0/300
Super K-1	7	0/300	POSF 2766 + 2656	44	300/300
POSF 2881 + 2786	9	300/25	POSF 2773	45	4/300
POSF 2843 + 2894	12	5/300	POSF 27/3	45 46	300/90
POSF 2908	13	300/5	POSF 2742 POSF 2769	46 46	300/90
POSF 2881 + 2913	13	255/165	POSF 2941	46	5/300
POSF 2913	15	300/180	POSF 2851	46 47	300/180
POSF 2881	16	300/6	POSF 2879	47 47	300/160
POSF 2786 + 25 mg/L 2843	16	19/300	POSF 2924	47	300/90
POSF 2843 +2730	16	5/300	POSF 2910	47	300/90
POSF 2894	16	0/300		48	
Super K-1 + POSF 2904	17	0/300	POSF 2730, 300 mg/L POSF 2786, 50 mg/L	48 48	4/300
POSF 2904 + 25 mg/L 2843	18	300/30	POSF 2880	46 48	200/400
POSF 2895	20	2/300			300/120
POSF 2843 + 2904 + 2913	20 21	2/300 8/300	POSF 2741 POSF 2884	48 49	22/300
POSF 2786 + 12 mg/L 2843	22	5/300	POSF 2912	49 50	300/94
POSF 2766 + 12 mg/L 2643 POSF 2843 + 2914	22	300/240	POSF 2996	50 50	176/300
POSF 2904 + 2851 + 2786	22 23	300/240			300/23
POSF 2843	23 24	300/20	POSF 2943	50 51	0/300
POSF 2843 + 2913	24 24	9/300	POSF 2737 POSF 2902	51 51	23/300
POSF 2926 Shell Oil Jet A	24 24	9/300 5/300		51 51	300/150
POSF 2926 Shell Oil Jet A POSF 2789	24 24	300/60	POSF 2946	51 52	0/300
POSF 2769 POSF N1	24 25	300/90	POSF 2720 5 mg/l	52 52	300/300
POSF 2904	25 25	300/40	POSF 2730, 5 mg/L POSF 2772	52 53	1/300
					300/210
POSF 2777 POSF2944	25 25	300/12	POSF 2733, 5 mg/L POSF 2763	54 54	0/300
		300/210		54 54	300/210
Jet A-1 Ref. +POSF 2904	26 26	200/4	POSF 2881 + 2914	54	300/33
POSF 2905	26 27	300/4	POSF 2914	55 55	4/300
POSF 2780	27	300/30	POSF 2947	55 56	1/300
POSF 2842	27	200/450	POSF 2898	56	300/180
POSF 2739	28	300/150	POSF 2788	56	300/300
POSF 2743	29	7/300	POSF 2938	57 50	300/145
POSF 2778	·32	300/56	POSF 2768	58	300/73
POSF 2786, 100 mg/L	32	4500	POSF 2734	61	120/300
POSF 2949 POSF 2899	32	4/300	POSF 2767	63	000/45
	33 33	300/240	POSF 2841	64	300/45
POSF 2907		300/10	POSF 2839	65 65	000.00
POSF 2854	34 34	300/120	POSF 2868	<b>6</b> 5	300/60
POSF 2921		222/452	POSF 2894 + 2727	<b>65</b>	300/180
POSF 2948 BOSE 2011	34 25	300/150	POSE N4	66 66	238/300
POSF 2911	35 36	300/39	POSF 2770	66 68	0.500
POSF 2787	36 37	300/90	POSF 2945	68	0/300
Exxon Jet A w/ 15% HC Stock	37 37	256/300	POSF 2760	69 60	7000
POSF 2906	37 37	10/300	POSF 2732	69 70	7/300
POSF 2733, 300mg/L	37	5/300 5/300	POSF 2835	70 71	300/10
POSF 2950	38 38	5/300	POSF 2790	71 70	300/17
POSF 2909	38	300/30	POSF 2870	72	
POSF 2940	38	1/300	POSF 2849	72	4/300
POSF 2856, 25 mg/L	40	300/113	POSF 2845	73	5/300
POSF 2927 POSF 2939	40 41	300/60 300/153	POSF 2877 POSF 2846	74 75	300/36
Note: The average value is show	n for replicate	runs			
See Appendix A for concentration	ıs		Table continued next page		

TABLE 2-1 Continued
HLPS RANKING OF FUELS, ADDITIVES, AND EXPERIMENTAL BLENDS EVALUATED TO DATE

Product Name	Carbon (µg/cm²)	Delta P/Time (mm Hg/min.)	Product Name	Carbon (ug/cm²)	Delta P/Time (mm Hg/min.
FIUOUCEIVAINE	(pg/ciii-)	(min rightiin.)	Froudel Name	(pg/ciir )	(min rightiin)
POSF 2833	78		POSF 2873	106	
POSF 2856, 100 mg/L	79		POSF 2782	106	
POSF 2756	80		POSF 2735	106	300/60
POSF 2731	82	1/300	POSF 2853	107	000.00
POSF 2785	85	300/70	POSF 2864	107	
POSF 2867	86	300/90	POSF 2952	108	300/150
POSF 2771	86	000/00	POSF 2757	108	5557.55
POSF 2867	86	300/90	POSF 2775	109	
POSF 2771	86	300/30	POSF 2784	112	
POSF 2728	88	8/300	POSF 2783	112	
POSF 2766	88	8/300	POSF 2752	113	
POSF 2766	88		POSF 2862	114	
POSF 2838	89	300/30	POSF 2872	117	300/5
POSF 2847	90	5/300	POSF 2844	122	300,0
POSF 2858	90	5,500	POSF 2859	123	
POSF 2745	90	0/300	POSF 2758	133	300/20
POSF 2897	91	0/300	POSF 2761	136	300/20
POSF 2837	91		POSF 2785	141	
POSF 2764	91		POSF 2726	142	
POSF 2737	93	4/300	POSF 2776	144	
POSF 2736	93	300/120	Jet A-1 Ref. Fuel	152	300/60
POSF 2860	93	300/120	POSF 2874	154	300/51
POSF 2754	95		POSF 2951	160	1/300
POSF 2781	96		POSF 2861	163	17500
POSF 2832	97		POSF 2738	218	300/182
POSF 2836	98	300/60	POSF 2850	227	300/102
POSF 2900	98	300/00	POSF 2774	262	
POSF 2751	98		POSF 2848	272	5/300
POSF 2840	98		POSF 2744	288	3/300
POSF 2762	99		POSF 2727	342	300/270
POSF 2878	100	300/36	POSF 2729	386	6/300
POSF 2865	100	300/36	POSF 2759	1404	18/300
POSF 2765	100		POSF 2881 + 2759	1504	11/300
POSF 2748	102		POSF 2834	Insoluble	11/300
POSF 2753	102		POSF 2871	Insolubie	
POSF 2869	104		POSF 2866	Insoluble	
POSF 2863	104		POSF 2876	**	300/20
POSF 2883	104		POSF 2855	**	300/20
POSF 2735	105	300/60	POSF 2866	Insoluble	
POSF 2755	106	300/00	POSF 2876	**	300/20
POSF 2852	106		POSF 2855	**	300/20
. 55. 25.5					
Note: The average value is s See Appendix A for concentr	•	runs	** plugged fuel line		

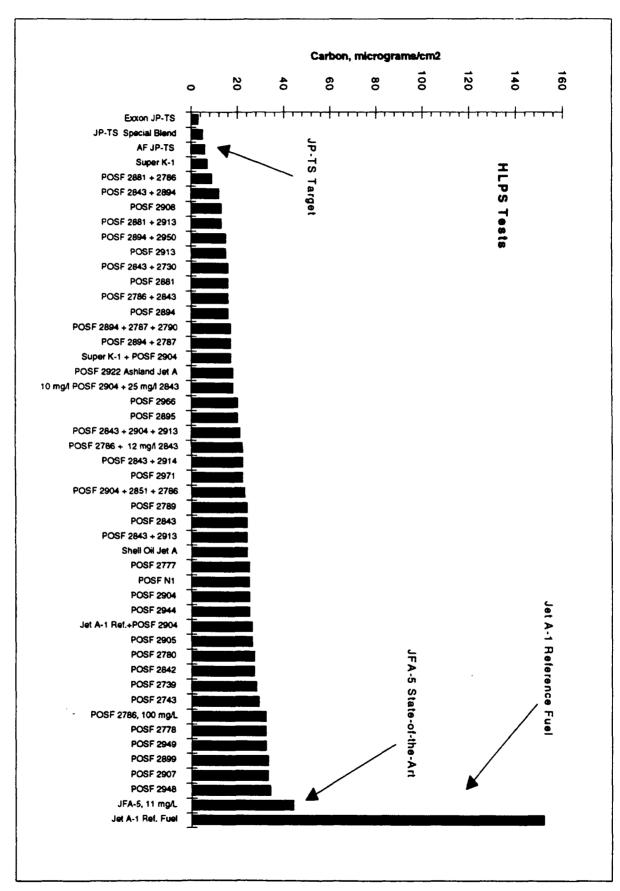


Figure 2-1. HLPS Ranking of the Top 50 Reference Fuels and Additive Blends

### TABLE 2-2 ICOT RANKING OF FUELS, ADDITIVES, AND EXPERIMENTAL BLENDS

	Filtered	Blower Tube		Filtered	Blower Tube
Sample	Carbon	Carbon	Sample	Carbon	Carbon
Name	Avg, μg	Avg. μg	Name	Avg, µg	Avg, μg
POSF 2894	397	590	POSF 2842	1148	567
POSF 2894+ 2727	468	68	POSF 2843	1166	553
POSF 2950	491	99	POSF 2789	1202	721
POSF 2909	494	324	POSF 2777	1204	662
POSF 2739	494	340	POSF 2913	1232	759
POSF 2884	528	564	POSF 2832	1272	12
POSF 2769	529	726	POSF 2951	1288	•
JP-TS	584	74	POSF 2949	1320	17
POSF N1	598	377	POSF 2741	1388	750
POSF 2880	604	424	POSF 2908	1391	569
POSF 2910	610	567	POSF 2927	1456	351
POSF 2944	650	393	POSF 2849	1457	225
POSF 2733	654	951	POSF 2786	1486	438
POSF 2773	666	721	POSF 2848	1672	468
POSF 2778	747	594	POSF 2901	1675	902
POSF 2787	785	100	POSF 2879	1710	541
POSF 2856, 25 mg/L	836	527	POSF 2847	1768	547
POSF 2907	862	309	Shell Jet A-1	1879	2417
POSF 2780	874	519	POSF 2845	1925	516
POSF 2939	874	505	POSF 2854	2016	562
POSF 2899	877	611	POSF 2895	2055	671
POSF 2856, 100 mg/L	883	707	POSF 2846	2104	605
POSF 2904	891	434	POSF 2952	2221	702
POSF 2786	900	497	POSF 2742	2365	1105
POSF 2948	908	169	FOSF 2851	2574	1727
Super K-1	947	97	POSF 2727	2944	113
POSF 2844	1009	2542	Jet A Ref.	2971	3196
POSF 2905	1045	321	POSF 2743	3655	642
POSF 2921	1046	414	POSF 2730	3938	398
Note: See Appendix A for repeatability					
	· · · · · · · · · · · · · · · · · · ·				

### 4.0 CONCLUSIONS

Based on HLPS tests, the most promising additives were those that significantly reduced both surface carbon and differential pressure. As shown in Table 2-1, three out of the top four performers were experimental blends that included POSF 2843 antioxidant. The fourth was a detergent/dispersant identified as POSF 2895. Based on ICOT tests, the most promising additives were those that significantly reduced both filtered carbon and blower tube carbon. One experimental blend, POSF 2894 + POSF 2727, and one single additive, POSF 2950, yielded lower filtered carbon than did JP-TS. POSF 2894 + POSF 2727 yielded both lower filtered carbon and blower tube carbon than the JP-TS target.

In addition to the above additives, a number of other candidates have been identified that in combination are expected to further the goal of meeting or exceeding the thermal stability properties of JP-TS. Considerable more work remains in the area of additive screening, experimental blends, test development and interpretation, second-level screening, larger-scale dynamic flowing tests, material compatibility, physical and chemical characterization, and com-ponent and engine tests.

The data generated and "lessons learned" during the course of this program have been transitioned to a follow-on Air Force funded effort entitled "An Integrated Approach to Improved Fuel System Design and Fuel Thermal Stability." The aforementioned program will continue the pursuit of the goals and objectives formulated for development and implementation of JP8+100.

### 5.0 APPENDICES

The following section includes Appendices A through C. Appendix A presents all HLPS and ICOT results; Appendix B all MTP results; and Appendix C all Fuel Reactor test results. Appendix A has been updated to include results compiled subsequent to the end of this technical effort.

			HLPS A	VD ICO	HLPS AND ICOT TEST RESULTS	ESULTS		Revised 12/02/93
			HLPS			ICOT		
POSF	Conc.	Carbon	dδ	Burn Off	Blower Tube	Blower Tube Filter Carbon	Burn Off	
Number	mg/L	ug/cm2	ug/cm2 mm Hg / Min.	Date	Carbon, ug	. ug	Date	Description / Supplier Recommended Dosage, mg/L
91-POSF-2855	52	Plugged 2 hrs in	2 hrs into run	12/6/91				AO (N type). Mixed polycycloaliphatic amines / 75 mg/L.
	5	99	238 in 300	3/11/92				AO (O type). Benzył alcohol
91-POSF-2856	100	79		9/24/91	780	923	1/11/93	AO (O type) tert-Butylhydroquinone (TBHQ)
					634	842		
					707	883	Avg.	
Retest at:	25	ຊ	300 in 60	3/27/92	462	805	1/11/93	The second secon
		22	300 in 60	4/3/92	591	966		
		44	300 in 220	4/24/92	527	836	Avg.	
		Avg: 40						
92-POSF-2899	25	33	300 in 240	3/3/92	603	867	12/10/92	AO (O type). 1-butanone oxime
					618	886		
					611	877	Avg.	
92-POSF-2897	25	91		10/10/91				
92-POSF-2900	25	96		8/14/91				AO (O type - vapor phase). Cyclohexanone oxime
92-POSF-2898	52	26	300 in 180	3/3/92	404	597	2/22/93	AO (O type - vapor phase). 2-cyclohexen-1-one
					341	413		
					373	505	Avg.	
90-POSF-2751	125	115		7/15/91				Stabilizer/Dispersant. Allphatic sulfonate subsituted aromatic,
		82		8/14/91				MDA + color stabilizer. 100-125 mg/L.
				00.200	001	0000	00,070	
92-FOSF-2895	3	R	2 III 3000	76/07/0	000	2476	76/19/2	Deterior Despendant. Perominent AF-114, Flobriedary
					647	1691		
					581	1871		
		1			671	2055	Avg	
92-POSF-2924	9	47	300 in 90	4/24/92	412	069	1/13/93	
					373	609		
					393	650	Avg.	
92-POSF-2901	2	44	300 in 300	8/3/92	879	1780	1/11/93	Proprietary stabilizer
					924	1570		
					902	1675	Avg.	

			HLPS A	ND ICO	HLPS AND ICOT TEST RESULTS	ESULTS		Revised 12/02/93
			HLPS			ICOT		
POSF	Conc.	Carbon	ďV	Burn Off	Blower Tube Filter Carbon	Filter Carbon	Burn Off	
Number	mg/L	ug/cm2 mm Hg /	mm Hg/Min.	Date	Carbon, ug	ug	Date	Description / Supplier Recommended Dosage, mg/L
92-POSF-2902	5	51	300 in 150	4/10/92	796	1408	2/22/93	Proprietary MDA
					948	1430		
					872	1419	Avg.	
								1
90-POSF-2790	\$	7	300 in 17°	10/5/92	541	1656	5/24/93	Proprietary stabilizer ("Line plugged at 150 minutes)
					280	1607		
					561	1632	Avg.	
92-POSF-2903	100	25	300 in 30	8/3/92	442	1019	2/22/93	Proprietary stabilizer
					435	1038		
					439	1029	Avg.	
90-POSF-2787	10	36	300 in 90	4/10/92	101	784	1/11/93	SPEC-AID 8Q400, Proprietary MDA. / 6 ppm
					86	785		
					100	785	Avg.	
92-POSF-2894	100	19	0 in 300	8/25/92	474	406	10/6/92	Detergent/Dispersant. (Thermoflo 7R19)
Repeat	100	13	5 in 300	11/4/92	603	413		
					542	373		
	50				741	397		
					590	397	Avg.	
Repeat ICOT					1536	2057	2/22/93	
					972	T		
					1254	1986	Avg.	
	100				1660	1320	5/25/93	
Repeat ICOT using mass flow controller					2110	942		
					1885	1131	Avg.	
POSF N3	5							Detergent / Dispersant (Thermoffo 7R30)
								- 1
91-POSF-2858	25	8		12/16/91				
91-POSF-2859	25	23		12/16/91				AO (O type). 4-tert-butylcatechol
91-POSF-2860	25	8		11/25/91				AO (O tyr. ). 2,5-di-t-butylhydroguinone

			てっした	20.02	I LEST I	HLPS AND ICOT TEST RESULTS		Revised 12/02/93
			HLPS			ICOT		
POSF	Conc.	Carbon	ď∇	Burn Off	Blower Tube	Filter Carbon	Burn Off	
Number	mg/L	ug/cm2	mm Hg/Min.	Date	Carbon, ug	οn	Date	Description / Supplier Recommended Dosage, mg/L
91-POSF-2861	25	163		11/25/91				AO (O type). Hydroquinone monobenzylether
91-POSF-2862	25	114		11/25/91				AO (O type). Hydroquinone monomethylether
91-POSF-2863	25	104		12/16/91				AO (O type). 2,2'-methylene bis(6-t-butyl-4-methylphenol)
91-POSF-2864	25	107		12/16/91				AO (O type). 4,4'-methylene bis(2,6-di-t-butylphenol)
91-POSF-2865	25	100		11/8/91				AO (O type). Pentaerythrityl tetra bis(3,5-di-t-butyl-4-
								듦
91-POSF-2866	25	Insoluble						
91-POSF-2867	25	98	300 in 90	1/17/92				AO (O type). 2,4,6-tris(3,5-di-t-butyl-4-hydroxyphenyl)-
								mesitylene.
91-POSF-2868	52	92	300 in 60	1/17/92				AO (O type). Tris(2-methyf-4-hydroxy-5-f-butyfphenyl)butane
91-POSF-2869	52	104		10/10/91				AO (O/S type). 4,4'-Thiobis(2,6-di-t-butylphenol)
91-POSF-2870	25	72		12/16/91				AO (O/N type) 2,6-di-t-butyt-o-dimethylamino-p-cresol
91-POSF-2871	52	Insoluble						AO (O/N type). N-lauroyl-p-aminophenol
91-POSF-2872	52	117	300 in 5	3/3/92				AO (O/N type). 2,4,6-tris(dimethy/aminomethy/)phenol
91-POSF-2873	52	106		12/16/91				AO (N type). N.Nbis(1,4-dimethylpentyl)-p-phenylenediamine
91-POSF-2874	25	154		1/17/92				AO (N type). N,N'bis(1-ethyl-3-methyl-pentyl)-p-phenytene-
92-POSF-2896	25	50	300 in 23	3/3/92	743	906	2/22/93	AO (O/N type). Di-p-methoxydiphenylamine
					941	1372		
					842	1139	Avg.	
91-POSF-2875	52	92	300 in 70	1/17/92				AO (N type). Dioctyldiphenylamine ("DODPA")
91-POSF-2876	52	Plugged	300 in 20	1/17/92				AO (N type). N.N'-diphenyl-p-phenylenediamine ("DPPD")
91-POSF-2877	25	74	300 in 36	2/5/92				- 1
91-POSF-2878	25	100	300 in 36	2/5/92				AO (N type). N-phenyl-N'-cyclohexyl-p-phenylenediamine
91-POSF-2879	25	47	300 in 54	1/17/92	618	2300	1/14/93	AO (N type). N-phenyl-1-naphthylamine ("PANA")
					463	1120		
					541	1710	Avg.	
91-POSF-2880	25	84	300 in 120	3/3/92	425	571	1/14/93	AO (N/S type). p-(p-toluenesulfonamide)diphenytamine
					423	637		
					424	604	Avg.	
91-POSF-2881	25	16	300 in 2	2/5/92				AO (N type). m-toluylenediamine (toluene-2,4-diamine)
Repeat	25	16	300 in 10	2/21/92		`		
91-POSF-2883	25	105		10/30/91				AO (O/S type). Dilaurylthiodipropionate
91-POSF-2884	25	49	300 in 94	1/17/92	608	575	1/14/93	≥
					519	481		. 1
					564	528	Avg.	

			HLPS A	ND ICO	HLPS AND ICOT TEST RESULTS	<b>ESULTS</b>		Revised 12/02/93
			HLPS			ICOT		
POSF	Conc.	Carbon	dδ	Burn Off	Blower Tube	Filter Carbon	Burn Off	
Number	mg/L	ug/cm2 mm Hg	mm Hg / Min.	Date	Carbon, ug	бn	Date	Description / Supplier Recommended Dosage, mg/L
00.DOSE-2741	300	48	22 in 300	R/25/92	202	1312	1/13/93	Determent / Dispersant for diesal friet 1500 mo/
	8	2			797	1463		
					750	1388	Avg.	
90-POSF-2742	52	46	300 in 90	10/5/92	1261	2542	1/11/93	Antioxidant Package for diesel fuel. 50 mg/L.
					1105	2365	Ava	
							n.	
90-POSF-2743	300	53	7 in 300	10/5/92	635	3548	12/9/92	Detergent / Dispersant for diesel fuel. 1500 mg/L.
					649	3761		
					642	3655	Avg.	
90-POSF-2744	1000	288		6/18/91				Detergent/Dispersant for gasolines. 1500 mg/L.
Drum #2	300	89	6 in 300	10/15/92				
90-POSF-2745	300	90	0 in 300	10/5/92				Detergent/Dispersant for gasolines. 1500 mg/L.
								- 1
92-POSF-2927	25	43	300 in 94	6/11/92	370	1433	1/11/93	AO (N type). N,N'-di-Isopropyl-p-phenylene diamine
Repeat		36	300 in 25	6/26/92	331	1478		
		Avg: 40			351	1456	Avg.	
91-POSF-2851	22	120		10/18/91	1647	2585	1/11/93	AO (O type). 2,6-di-t-butyl-4-methylphenol (BHT,
Repeat		47	300 in 180	6/11/92	1807	2562		IONOL) / 16 - 32 mg/L.
					1727	2574	Avg.	
0700 2000	4	3	476 in 900	00/0/8	100	css	00000	Description: Disnormant (Methodogle base) / E-mail
3153-1501-28	D	8	300	DISIDE	383	796	25033	Topicomy Disperson (Mentacyfiake type) 7 11191
					332	935	Avg.	
	ļ							
92-POSF-2913	2	15	300 in 180	3/27/92	269	1603	12/9/92	Proprietary Dispersant (Styrene monomer) / 5 mg/L
					821	861		
					759	1232	Avg.	
Repeat	22				384	1141	2/24/93	
					414	1084		
					399	1113	Avg.	

			HLPS A	ND ICO	T TEST A	HLPS AND ICOT TEST RESULTS		Revised 12/02/93
			HLPS			ICOT		
POSF	Conc.	Carbon	ΔP	Burn Off	Blower Tube	Filter Carbon	Burn Off	
Number	mg/L	ug/cm2 mm Hg /	mm Hg/Min.	Date	Carbon, ug	gn	Date	Description / Supplier Recommended Dosage, mg/L
92-POSE-2914	ĸ	55	4 in 300	5/29/92	462	892	2/24/93	Proprietary Dispersant / 5 mg/L
					515	819		
					489	956	Avg.	
200 0000	•	9	000	6/45/04	900	730	40/5/02	AO/Dien AIDA Dran comm (mathematete politimes
30.F.OSF-27.08	=	47	200	6/17/91	511	925	3000	+ MDA / 12 ma/
		49		6/20/91	576	927		, and the same of
		40		7/15/91	613	882		
		33		7/15/91	497	006	Avg.	
		37		7/15/91	146	30	S.D.	
	7	29	0 in 300	6/26/92	929	1182	5/20/93	Duplicate HLPS tests performed by two different operators on
	-	တ	0 in 300	6/26/92	795	1070		the same day.
					862	1126	Avg.	
	20	40		9/11/91	546	1297	1/13/93	
		22		9/11/91	330	1674		
		Avg: 49			438	1486	Avg.	
	100			9/11/91				
		&		9/11/91				
14 0000	Ç	36	Oo al ooc	207702	226	903	00/0/0+	Some as MOA ( 5 g yram May
N Leon	2	3	200	361136	398	599	2000	
					377	598	Avg.	
92-POSF-2904	5	<b>5</b> 8		11/8/91				
92-POSF-2905	10	24	300 in 4	4/15/92	306	1084	12/8/92	MDA. N,N'-disalicylidene-1,2-diaminocyclohexane &
					335	1006		solvent, 5.8 mg/L.
	1				321	1045	Avg.	
	10	28	300 in 5	4/24/92				
92-POSF-2904	<b>5</b>	25	300 in 40	4/3/92	409	668	12/8/92	MDA. N,N'-disalicylidene-1,2-propanediamine &
					459	883		solvent. / 5.8 mg/L.
					434	891	Avg	1
91-POSF-2852	52	82		10/18/91				AO (N type). Organic Amines / 60 mg/L.

FDOSF   POSF   Conc.   Carbon   AP   Burn Or   Bower Tibes Flare Carbon   Burn Or   Bower Tibes Flare Carbon   Burn Or   Bower Tibes Flare Carbon   Burn Or   Carbon   Carbo				HLPS A	ND ICO	HLPS AND ICOT TEST RESULTS	ESULTS		Revised 12/02/93
POSF         Conc.         Carbon         AP         Burn Off         Blower Tube Filler Carbon         LOT         Burn Off         Blower Tube Filler Carbon         LOT         AO (NI)           F2853         25         107									
POSF         Conc         Carbon         AP         Burn Off         Blower Tube Filter Carbon         Burn Off         Burn Off         Burn Off         Burn Off         Burn Off         Date         Carbon, ug         · ug         Date         AD           F-2854         25         34         107         107/891         607         784         127/162         AO/MO           F-2854         25         34         300 in 210         107/891         607         784         127/162         RoAM           F-2854         25         34         110 300         67/82         607         784         127/162         Same a           F-2806         25         41         18 in 300         67/82         607         784         127/162         Same a           F-2807         25         41         18 in 300         67/82         607         784         127/162         Same a           F-2807         25         41         18 in 300         67/82         423         14/9         17/163         Same a           F-2807         25         33         300 in 30         67/82         250         489         14/9         17/163         Invisor           F-2807				HLPS			ICOT		
Number         mg/L         ug/cm2         mmtHg/ Min         Date         Castoon, ug         . ug         Date         Acorkol           F-2853         25         107         10718041         601         2061         1271192         Acorkol           F-2854         25         34         10718041         601         2061         1271192         Acorkol           F-2806         25         33         1 n 300         5/1/82         607         794         12/1/602         Same a           F-2906         25         41         18 in 300         6/2692         483         489         489         Avg         Fepada           F-2907         25         33         1 in 300         6/2692         250         881         12/1/802         Same a           F-2907         25         33         300 in 10         5/1/82         250         881         Avg         Avg         Avg         Avg         Avg         Avg         Fepada         Avg         Avg </th <th>POSF</th> <th>Conc.</th> <th>Carbon</th> <th></th> <th>Burn Off</th> <th>Blower Tube</th> <th></th> <th>Burn Off</th> <th></th>	POSF	Conc.	Carbon		Burn Off	Blower Tube		Burn Off	
F-2853         25         107         10/1891         601         2081         12/1022           F-2854         25         34         10/1891         601         2081         12/1022           F-2854         25         34         300 in 210         10/1892         522         1951         40           F-2806         25         33         1 in 300         5/1/92         607         794         12/1682           F-2807         25         41         1 in 300         6/2692         545         843         12/1682           F-2807         25         33         300 in 10         5/1/82         280         843         1/1783           F-2808         25         13         300 in 10         5/1/82         280         843         1/1/183           F-2808         25         13         300 in 10         5/1/82         275         1/238         1/1/183           F-2810         25         38         300 in 30         5/1/82         373         1/1/183           F-2810         25         38         300 in 30         5/1/82         434         Avg.           F-2811         25         35         300 in 30         5/1/82	Number	mg/L	ug/cm2	mm Hg	Date	Carbon, ug	۵n .	Date	Description / Supplier Recommended Dosage, mg/L
F-2853         25         107         10/18/91         601         2081         12/11/92           F-2854         55         34         300 in 210         10/18/92         622         1951         12/11/92           F-2806         25         33         1 in 300         5/1/92         607         794         12/16/92           F-2906         25         41         18 in 300         6/7/92         667         794         12/16/92           F-2906         25         41         18 in 300         6/7/92         667         794         12/16/92           F-2907         25         33         300 in 10         6/1/92         230         881         12/11/92           F-2908         25         13         300 in 5         5/1/82         230         882         Avg           F-2910         25         13         300 in 5         5/1/82         315         Avg           F-2910         25         38         300 in 30         5/1/82         434         Avg           F-2911         25         38         300 in 30         5/1/82         434         Avg           F-2911         25         35         300 in 30         5/1/82									
F-2854         25         34         10/18/91         601         2081         12/11/92           F-2906         45         300 in 210         5/1/82         652         2016         Avg.           F-2906         25         43         1 in 300         5/1/82         607         7/94         12/16/82           F-2907         25         41         18 in 300         6/1/82         280         8843         Avg.           F-2907         25         33         300 in 10         5/1/82         280         8843         Avg.           F-2907         25         13         300 in 5         5/1/82         275         1/238         Avg.           F-2908         25         13         300 in 5         5/1/82         5/7         1/238         Avg.           F-2910         25         13         300 in 5         5/1/82         1/39         1/1/93           F-2910         25         38         300 in 30         5/1/82         434         Avg.           F-2910         25         38         300 in 30         5/1/82         616         877         1/1/9/3           F-2911         25         35         300 in 30         5/1/82	91-POSF-2853	52	107		10/18/91				Amino Amide / 100 mg/L.
F-2906         50         45         300 in 210         10/592         520         1951         Avg           F-2906         25         33         1 in 300         5/1/82         607         794         12/16/82           F-2906         25         41         16 in 300         6/58/92         483         12/16/82           F-2907         25         33         300 in 10         6/78/2         250         881         12/16/82           F-2907         25         33         300 in 5         5/1/82         250         881         12/16/82           F-2908         25         13         300 in 5         5/1/82         250         881         1/1/162           F-2909         25         13         300 in 5         5/1/82         375         1/2         1/1/163           F-2910         25         47         300 in 40         5/1/82         315         474         Avg           F-2910         25         47         300 in 40         5/1/82         434         621         1/1/163           F-2910         25         47         300 in 40         5/1/82         616         677         1/2/16/2           F-2911         25	91-POSF-2854	25	34		10/18/91	601	2081	12/11/92	AO/MDA. Organic Amines + Metal deactivator 64 mg/L.
F-2906         26         33         1 in 300         5/1/82         607         794         12/16/82           F-2907         25         41         18 in 300         6/26/82         607         794         12/16/82           F-2907         25         41         18 in 300         6/26/82         545         843         Avg.           F-2907         25         33         300 in 10         5/1/82         290         881         12/1/82           F-2908         26         13         300 in 10         5/1/82         290         881         12/1/82           F-2908         26         13         300 in 30         5/1/82         5/7         1/236         Avg.           F-2909         26         13         300 in 30         5/1/82         5/7         1/39         1/1/39           F-2910         26         47         300 in 30         5/1/82         434         621         1/1/39           F-2910         26         47         300 in 30         5/1/82         434         621         1/1/39           F-2911         26         35         300 in 30         5/1/82         616         877         1/1/199           F-2911	Repeat	25	45	300 in 210	10/5/92	522	1951		Repeat test to evaluate at supplier recommended dosage.
F-2906         25         31         1 in 300         6/1/92         607         794         12/16/92           F-2907         25         41         18 in 300         6/26/92         483         899         Avg.           F-2907         25         33         300 in 10         5/1/82         290         881         12/1/82           F-2908         25         13         300 in 5         5/1/82         290         883         Avg.           F-2908         25         13         300 in 5         5/1/82         5/7         1/239         Avg.           F-2908         25         13         300 in 30         5/1/82         5/7         1/239         Avg.           F-2909         25         38         300 in 30         5/1/82         315         473         1/1/83           F-2910         25         38         300 in 30         5/1/82         334         494         Avg.           F-2911         25         35         300 in 39         5/1/82         616         877         1/1/82           F-2911         25         35         300 in 120         5/1/82         448         936         1/1/1/82           F-2921         2						295	2016	Avg.	
F-2906         25         33         1 in 300         5/1/92         607         734         12/16/82           F-2907         25         41         18 in 300         6/26/92         483         889         12/11/82           F-2907         25         33         300 in 10         6/1/92         280         881         1/2/11/82           F-2908         25         13         300 in 5         5/1/92         575         1238         Avg           F-2909         25         13         300 in 5         5/1/92         576         1536         Avg           F-2910         25         38         300 in 30         5/1/92         315         473         1/11/93           F-2910         25         38         300 in 30         5/1/92         315         473         1/11/93           F-2910         25         38         300 in 30         5/1/92         315         474         Avg           F-2910         25         38         300 in 30         5/1/92         616         Avg           F-2911         25         35         300 in 30         5/1/92         616         600         Avg           F-2911         25         35 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>									
F2907         25         41         18 in 300         6/26/92         483         889         Avg.           F2907         25         33         300 in 10         5/1/92         290         881         12/1/92           F2908         25         13         300 in 5         5/1/92         290         881         12/1/92           F2908         25         13         300 in 5         5/1/92         575         1/238         1/21           F2908         25         13         300 in 5         5/1/92         575         1/238         1/21           F2909         25         38         300 in 30         5/1/92         315         4/3         1/1/1/93           F2910         25         39         300 in 30         5/1/92         324         494         Avg.           F2910         25         35         300 in 30         5/1/92         616         8/7         1/1/1/93           F2911         25         35         300 in 30         5/1/92         616         8/7         1/1/1/93           F2911         25         35         300 in 120         5/1/92         616         8/7         1/1/1/92           F2921         25 <td>92-POSF-2906</td> <td>52</td> <td>33</td> <td>1 in 300</td> <td>5/1/92</td> <td>209</td> <td>794</td> <td>12/16/92</td> <td>Same as JFA-5, except different dispersant</td>	92-POSF-2906	52	33	1 in 300	5/1/92	209	794	12/16/92	Same as JFA-5, except different dispersant
F-2907         25         33         300 in 10         5/1/82         290         881         12/11/82           F-2907         25         33         300 in 10         5/1/82         290         881         12/11/82           F-2908         25         13         300 in 5         5/1/92         575         1238         Avg.           F-2908         25         13         300 in 5         5/1/92         576         158         Avg.           F-2910         25         38         300 in 30         5/1/82         315         4/3         1/1/193           F-2910         25         47         300 in 40         5/1/82         434         621         1/1/193           F-2911         25         47         300 in 40         5/1/82         434         Avg.           F-2911         25         47         300 in 30         5/1/82         616         Avg.           F-2911         25         35         300 in 30         5/1/82         616         Avg.           F-2911         25         35         300 in 30         5/1/82         616         Avg.           F-2911         25         35         300 in 30         5/1/82 <td< td=""><td>Repeat</td><td>25</td><td>41</td><td>18 in 300</td><td>6/26/92</td><td>483</td><td>688</td><td></td><td></td></td<>	Repeat	25	41	18 in 300	6/26/92	483	688		
25     33     300 in 10     \$/1/92     290     881     12/11/92       26     13     300 in 5     \$/1/92     575     1238     Avg.       26     13     300 in 5     \$/1/92     575     1238     Avg.       26     13     300 in 5     \$/1/92     575     1238     Avg.       26     13     300 in 30     \$/1/92     569     1361     Avg.       26     47     300 in 40     \$/1/92     473     4/13     4/13       26     47     300 in 40     \$/1/92     434     621     1/1/193       25     35     300 in 39     \$/1/92     616     877     1/1/193       25     35     300 in 39     \$/1/92     616     877     1/1/193       25     35     300 in 39     \$/1/92     616     877     1/1/193       25     35     300 in 120     \$/1/92     448     836     12/1/92       25     35     300 in 120     \$/1/92     448     836     12/1/92       26     35     300 in 120     \$/1/92     448     836     12/1/92       48     414     1046     Avg.						545	842	Avg.	
25         33         300 in 10         5/1/92         290         881         12/1/92           326         843         843         843         436         12/1/92         843         436         12/1/92         443         449									
25       13       300 in 5       5/1/92       575       1238       Avg.         26       13       300 in 5       5/1/92       575       1238       Avg.         26       13       300 in 120       5/1/92       575       1238       Avg.         26       13       11811       666       1569       1576       Avg.         26       38       300 in 30       5/1/82       315       473       1/1/163         26       38       300 in 30       5/1/82       315       473       1/1/163         26       47       300 in 40       5/1/82       434       621       1/1/163         27       47       300 in 40       5/1/82       616       877       1/1/1692         28       35       300 in 120       5/1/82       616       877       1/1/1692         28       35       300 in 120       5/1/82       448       936       1/1/1692         29       380       1156       Avg       1046       Avg	92-POSF-2907	25	33	300 in 10	5/1/92	290	188	12/11/92	Similar to JFA-5, except different AO and dispersant
25   13   300 in 5   5/1/92   575   1236   Avg.     25   13   300 in 5   5/1/92   575   1236   1581   188						328	843	J	
25     13     300 in 5     5/1/92     575     1238       439     1181     439     1181       666     1569     1569     1576       26     38     300 in 30     5/1/82     315     473     1/1/193       26     38     300 in 30     5/1/82     315     474     4/1       26     47     300 in 40     5/1/82     434     621     1/1/3/93       26     35     300 in 39     5/1/82     616     8/7     1/1/6/92       26     35     300 in 120     5/1/82     616     8/7     1/1/6/92       26     35     300 in 120     5/1/82     616     8/7     1/2/1/6/92       26     35     300 in 120     6/1/82     448     936     1/2/1/6/92       26     35     300 in 120     6/1/82     448     936     1/2/1/6/92       27     36     36     1156     A/9     A/9						309	862	Avg.	
25 13 300 in 5 5/1/92 5,75 1238									
439 1181 666 1569 1569 666 1569 656 1569 656 1569 656 1569 656 1576 659 1391 Avg 550 Avg 550 Avg 550 1391 Avg 550 Avg 55	92-POSF-2908	25	13	300 in 5	5/1/92	575	1238		Same as JFA-5, except different dispersant
25       38       300 in 30       5/1/92       315       473       1/11/93         25       38       300 in 30       5/1/92       315       473       1/11/93         25       47       300 in 40       5/1/92       434       621       1/13/93         25       47       300 in 40       5/1/92       434       621       1/13/93         26       35       300 in 39       5/1/92       616       8vg.         26       35       300 in 39       5/1/92       616       8vg.         26       35       300 in 120       5/1/92       448       936       12/1/92         27       26       35       300 in 120       5/1/92       448       936       12/1/92						439	1181		
25       38       300 in 30       5/1/92       315       473       1/11/93         25       38       300 in 30       5/1/92       315       473       1/11/93         25       47       300 in 40       5/1/92       434       621       1/13/93         25       47       300 in 40       5/1/92       434       621       1/13/93         25       35       300 in 39       5/1/92       616       877       12/16/92         25       35       300 in 120       5/1/92       616       877       12/16/92         25       35       300 in 120       5/1/92       448       936       12/11/92         25       35       300 in 120       5/1/92       448       936       12/11/92         25       35       300 in 120       5/1/92       448       936       12/11/92         26       35       300 in 120       5/1/92       448       936       12/11/92         380       1156       Avg         414       1046       Avg						999	1569		
25       38       300 in 30       5/1/92       315       473       1/11/93         26       38       300 in 30       5/1/92       315       473       1/11/93         26       47       300 in 40       5/1/92       434       484       Avg.         25       47       300 in 40       5/1/92       434       621       1/13/93         26       47       300 in 39       5/1/92       616       877       1/1/6/92         26       35       300 in 120       5/1/92       616       877       12/16/92         25       35       300 in 120       5/1/92       448       936       12/11/92         26       35       300 in 120       5/1/92       448       936       12/11/92         26       35       300 in 120       5/1/92       448       936       12/11/92						969	1576		
25       38       300 in 30       5/1/92       315       473       1/11/93         333       514       333       514       494       Avg.         25       47       300 in 40       5/1/92       434       621       1/13/93         25       47       300 in 40       5/1/92       616       Avg.         25       35       300 in 39       5/1/92       616       8/7       12/16/92         25       35       300 in 120       5/1/92       448       936       12/11/92         25       35       300 in 120       5/1/92       448       936       12/11/92						569	1391	Avg	
25         38         300 in 30         5/1/92         315         473         1/11/93           333         514         333         514         1/11/93           25         47         300 in 40         5/1/92         434         621         1/13/93           25         47         300 in 40         5/1/92         434         621         1/13/93           25         35         300 in 39         5/1/92         610         Avg.           25         35         300 in 120         5/1/92         616         877         12/16/92           25         35         300 in 120         5/1/92         448         936         12/11/92           25         35         300 in 120         5/1/92         448         936         12/11/92           25         35         300 in 120         5/1/92         448         936         12/11/92									
25       47       300 ln 40       5/1/92       434       621       1/13/93         25       47       300 ln 40       5/1/92       434       621       1/13/93         25       35       300 ln 39       5/1/92       610       Avg.         25       35       300 ln 39       5/1/92       616       877       12/16/92         25       35       300 ln 120       5/1/92       448       936       12/11/92         25       35       300 ln 120       5/1/92       448       936       12/11/92         360       414       1046       Avg.	92-POSF-2909	25	38	300 in 30	5/1/92	315	473	1/11/93	Similar to JFA-5, except different AO and Dispersant
25       47       300 in 40       5/1/92       434       621       1/13/93         26       47       300 in 40       5/1/92       434       621       1/13/93         700       599       700       599       1/13/93         25       35       300 in 39       5/1/92       616       877       12/16/92         8       25       35       300 in 120       5/1/92       900       Avg.         8       25       35       300 in 120       5/1/92       448       936       12/11/92         9       25       35       300 in 120       5/1/92       448       936       12/11/92						333	514		The second secon
25     47     300 in 40     5/1/82     434     621     1/13/93       700     599     700     599     1/13/93       25     35     300 in 39     5/1/92     616     8/7     12/16/92       25     35     300 in 120     5/1/92     448     936     12/11/92       25     35     300 in 120     5/1/92     448     936     12/11/92       380     1156     Avg.						324	494	Avg.	
25         47         300 in 40         5/1/82         434         621         1/13/93           700         599         700         599         1/13/93           25         35         300 in 39         5/1/92         616         Avg.           25         35         300 in 120         5/1/92         616         877         12/16/92           25         35         300 in 120         5/1/92         448         936         12/11/92           25         35         300 in 120         5/1/92         448         936         12/11/92           380         1156         Avg.									
25 35 300 in 39 5/1/92 616 877 12/16/92 536 923 676 900 Avg.  25 35 300 in 120 5/1/92 448 936 12/11/92 380 1156 Avg.	92-POSF-2910	25	47	300 in 40	5/1/82	434	621	1/13/93	Two different AO types + DMD @ 40% found in JFA-5
25       35       300 in 39       5/1/92       616       877       12/16/92         535       923       576       900       Avg.         25       35       300 in 120       5/1/92       448       936       12/11/92         26       35       300 in 120       5/1/92       448       936       12/11/92         380       1156       Avg.						8	565		
25     35     300 in 39     5/1/92     616     877     12/16/92       535     923     87     12/16/92       576     900     Avg.       25     35     300 in 120     5/1/92     448     936     12/11/92       380     1156       414     1046     Avg.						267	610	Avg.	
535     923       576     900     Avg.       25     35     300 in 120     5/1/92     448     936     12/11/92       380     1156       414     1046     Avg.	92.POSE.2911	35	35		5/1/92	616	877	12/16/92	Three different AOs + DMD @ 60% found in JFA-5
25 35 300 in 120 5/1/92 448 936 12/11/92 380 1156 409.						535	923		
25 35 300 in 120 5/1/82 448 936 12/11/92 12/11/92 380 1156 448 936 448 936 12/11/92						929	06	Avg.	
25 35 300 in 120 5/1/92 448 936 12/11/92 1300 in 150 12/11/92 1414 1046 Avg.									The second of the second secon
1156	92-POSF-2921	25	32	300 in 120	5/1/92	448	936	12/11/92	Different from JFA-5: Proprietary
1046						380	1156		
						414	1046	Avg.	Section 1
					- <del></del>				

HLPS				HLPS A	ND ICO	T TEST F	AND ICOT TEST RESULTS		Revised 12/02/93
HIPS   HOSF									
POSF   Conc.   Carbon   AP   Burr Orl   Blower Tube   Filler Carbon   Burn Orl   Burr				HLPS			ICOT		
Sample   Mumber   mg/L   ug/cm2   mm Hg / Mm   Date   Carbon ug   ug   Date   Datescript   E-2989   15	POSF	Conc.	Carbon	ΔP	Burn Off	Blower Tube	Filter Carbon	Burn Off	
F-2886   15   10   10   10   10   10   10   10	Number	mg/L	ug/cm2			Carbon, ug	δn	Date	Description / Supplier Recommended Dosage, mg/L
F-2946   15   AO In JrA 50 [AF 50]   AO In									
F-2968         15         New JFA-5           F-2748         200         102         6/20/91         Stabilizer / exter           F-2759         100         133         300 in 20         6/20/91         AO (O type)           F-2759         25         104         6/20/91         AO (O type)         AO (O type)           F-2754         25         104         6/20/91         AO (O type)         AO (O type)           F-2754         25         108         11/2561         AO (O type)         AO (O type)           F-2755         25         108         11/2561         AO (O type)         AO (O type)           F-2756         25         108         11/2561         1134         1378         AO (O type)           F-2756         25         106         11/2561         1134         1378         AO (O type)           F-2832         25         97         11/2561         1242         1272         Avg           F-2833         25         106         11/2561         1242         1272         Avg           F-2834         25         89         300 in 60         2/592         AO (I type)         AO (I type)           F-2835         25         89	POSF NS	52							AO in JFA-5 (Amino Amide)
F-2748         200         102         6/20/91         Stabilize / exter           F-2758         100         133         300 ln 20         6/20/91         Deletigent / Dispense	93.POSE-2988	51							New'. IFA-5
F-2758         200         102         6/20/91         Stablizar / extended           F-2758         100         133         300 in 20         6/25/92         Deletigent / Display           F-2752         25         103         6/25/92         AO (O lype)         AO (O lype)           F-2753         25         104         6/25/92         AO (O lype)         AO (O lype)           F-2754         25         109         11/25/91         AO (O lype)         AO (O lype)           F-2755         25         109         11/15/91         11349         127/72         AO (O lype)           F-2756         25         90         11/15/91         11/26/91         AO (O lype)         AO (O lype)           F-2832         25         97         11/15/91         1242         127/22         AO (O lype)           F-2833         25         97         11/15/91         1242         1772         AO         AO (O lype)           F-2834         25         97         11/15/91         12/22         AO         AO (O lype)         AO         AO (O lype)         AO           F-2834         25         97         11/15/91         12/22         AO         AO         AO         AO									
F-2758         200         102         6/25/92         Stabilizar ( exter)           F-2758         100         133         300 in 20         6/25/92         Deletgent / Dist           F-2753         25         113         10/30/91         AO (O type)         AO (O type)           F-2753         25         104         10/30/91         AO (O type)         AO (O type)           F-2754         25         108         11/15/91         AO (O type)         AO (O type)           F-2755         25         80         11/15/91         AO (O type)         AO (O type)           F-2832         25         80         11/15/91         AO (O type)         AO (O type)           F-2833         25         78         10/10/91         AO (O type)         AO (O type)           F-2834         25         70         300 in 60         25/92         AO (O type)         AO (O type)           F-2835         25         70         300 in 75         25/92         AO (O type)         AO (O type)           F-2836         25         98         300 in 75         25/92         AO (O type)         AO (O type)           F-2836         25         98         300 in 60         25/182         AO (O type)<									
F-2758         100         133         300 in 20         6/25/92         Delaigent / Disp.         PO (O type)         9           F-2752         25         104         10/30/91         40 (O type)         40 (O type)         9           F-2753         25         104         10/10/91         11/15/91         40 (O type)         AO (O type)	90-POSF-2748	200	102		6/20/91				Stablizer / extender. "Animal and vegetable fats"?!
F-2752         25         113         10/30/91         AO (O kype)	90-POSF-2758	100	133	300 in 20	8/25/92				Detergent / Dispersant, Imidazoline, substituted fattv
F-2753         25         104         6620/91           F-2754         25         95         10710/81         AO (O kpe) . AO (	90-POSF-2752	25	113		10/30/91				
F-2754         25         95         1010081         AO (O type) 0 40 (O type) 1 (O type) 2 (O type) 3 (O	90-POSF-2753	52	<u>5</u>		6/20/91				AO (O/N type). 98% min. 2,6-di-t-butylalphadimethylamino-
F.2157         25         108         11/25/81         AO (O type)           F.2155         25         106         11/15/81         AO (O type)           F.2156         25         80         11/15/81         AO (O type)           F.2832         25         80         11/15/81         1134         1378         12/7/92         AO (O type)           F.2833         25         78         10/10/81         1242         17/2         Avg         AO (N type)           F.2834         25         78         10/10/81         25/82         AO (N type)         AO (N type)           F.2835         25         98         300 in 10         2/5/82         AO (N type)         AO (N type)           F.2836         25         91         300 in 75         2/5/82         AO (N type)         AO (N type)           F.2836         25         93         300 in 75         2/5/82         AO (N type)         AO (N type)           F.2837         25         93         300 in 75         2/5/82         AO (N type)         AO (N type)           F.2840         25         98         300 in 60         2/2/82         AO (N type)         AO (N type)           F.2841         25         98	90-POSF-2754	25	95		10/10/91				၈
F-2755         106         12/16/891         AO (O type)           F-2756         25         80         11/15/91         AO (O type)           F-2832         25         97         11/25/91         1134         1378         127/82         AO (N type)           F-2832         25         78         10/10/91         1242         1272         AVG         AO (N type)           F-2833         25         78         10/10/91         12/22         AVG         AO (N type)         AO (N type)           F-2836         25         91         25/82         AO (N type)         AO (N type) <td>90-POSF-2757</td> <td>25</td> <td>108</td> <td></td> <td>11/25/91</td> <td>į</td> <td></td> <td></td> <td>1</td>	90-POSF-2757	25	108		11/25/91	į			1
F-2756         25         80         11/15/91         A0 (O type)           F-2832         25         97         11/25/91         1134         1378         127/92         AO (N type)           F-2833         25         78         10/10/91         1242         1272         Avg         AO (N type)           F-2835         25         78         10/10/91         1242         1272         Avg         AO (N type)           F-2835         25         70         300 in 10         2/5/92         AO (N type)         AO (N type)           F-2836         25         98         300 in 30         2/5/92         AO (N type)         AO (N type)           F-2837         25         98         300 in 75         2/5/92         AO (N type)         AO (N type)           F-2839         25         98         300 in 75         2/5/92         AO (N type)         AO (N type)           F-2840         25         98         10/18/91         AO (N type)         AO (N type)           F-2841         26         173         10/18/91         347         1162         AO (N type)           F-2842         25         27         300 in 14         4/3/92         567         11/48         <	90-POSF-2755	52	106		12/16/91				- 1
F-2832         25         97         11/25/91         1134         1378         127/92         AO (N type)           F-2833         25         78         10/10/91         1242         1272         Avg           F-2834         25         70         300 in 10         2/5/82         AO (N type)           F-2835         25         70         300 in 10         2/5/82         AO (N type)           F-2836         25         98         300 in 60         2/5/82         AO (N type)           F-2837         25         98         300 in 75         2/5/82         AO (N type)           F-2838         25         98         300 in 75         2/5/82         AO (N type)           F-2839         25         98         10/30/91         AO (N type)           F-2840         25         98         10/30/91         AO (N type)           F-2841         25         98         10/30/91         AO (N type)           F-2842         25         98         10/30/91         AO (N type)           F-2842         25         113         10/30/91         AO (N type)           F-2842         25         300 in 60         3/21/92         AO (N type)	90-POSF-2756	52	80		11/15/91				
F-2833         25         76         10/10/91         1242         1272         Avg.           F-2834         25         78         10/10/91         1242         1272         Avg.           F-2834         25         70         300 in 10         2/5/92         AO (N type)           F-2835         25         98         300 in 60         2/5/92         AO (N type)           F-2836         25         91         12/16/91         AO (N type)           F-2836         25         93         300 in 50         2/5/92         AO (N type)           F-2837         25         93         300 in 75         2/5/92         AO (N type)           F-2839         25         65         11/6/91         AO (N type)           F-2840         25         98         300 in 60         2/2/92         AO (N type)           F-2841         25         98         10/18/91         AO (N type)           F-2842         25         173         10/18/91         AO (N type)           F-2842         25         300 in 60         2/2/92         AO (N type)           F-2842         25         300 in 60         3/2/92         AO (N type)           F-2842	0000 1000 10	30	0.7		11/05/01	7077	4970	107762	AO (N broad) Acomodic amiro
F-2833         25         78         10/10/91         1242         1100         Aug         AO (O/8 type)           F-2834         25         78         10/10/91         12/22         1272         Avg         AO (N type)           F-2835         25         70         300 in 10         25/92         AO (N type)         AO (N type)           F-2836         25         91         12/16/91         AO (N type)         AO (N type)           F-2837         25         93         300 in 75         25/92         AO (N type)           F-2838         25         93         300 in 75         25/92         AO (N type)           F-2839         25         98         11/8/91         AO (N type)           F-2840         25         98         10/30/91         AO (N type)           F-2841         25         98         10/30/91         AO (N type)           F-2840         25         98         10/30/91         AO (N type)           F-2841         25         173         10/18/91         AO (N type)           F-2842         25         300 in 60         3/27/92         AO (N type)           F-2842         25         300 in 74         4/3/92         567	91-1031-2032	63	ò		11/20/31	1340	1370	2611135	AC (18 type). At Olivano difficie
F 2833         25         78         10/10/91         CPC         CPC         AC (O/S type)           F 2834         25         70         300 in 10         2/5/92         AC (N type)           F-2836         25         70         300 in 10         2/5/92         AC (N type)           F-2836         25         91         12/16/91         AC (N type)           F-2837         25         93         300 in 75         2/5/92         AC (N type)           F-2838         25         93         300 in 75         2/5/92         AC (N type)           F-2839         25         98         11/8/91         AC (N type)           F-2840         25         98         10/30/91         AC (N type)           F-2841         25         173         10/18/91         AC (N type)           F-2842         25         173         10/18/91         AC (N type)           F-2841         25         173         10/18/91         AC (N type)           F-2842         25         27         10/18/91         AC (N type)           F-2842         25         30 in 14         4/3/92         567         1148         AVg           AVG: 33         AVG: 33		+				6764	1979	Ave	
F-2835         25         Insoluble         O'1051           F-2836         25         Insoluble         AO (N type)           F-2836         25         98         300 in 60         25/92         AO (N type)           F-2836         25         91         12/16/91         AO (N type)           F-2837         25         93         300 in 75         25/92         AO (N type)           F-2838         25         98         11/18/91         AO (N type)           F-2839         25         65         11/18/91         AO (N type)           F-2840         25         98         10/30/91         AO (N type)           F-2841         25         173         10/18/91         AO (N type)           F-2842         25         173         10/18/91         AO (N type)           F-2842         25         300 in 60         22/19/2         AO (N type)           F-2842         25         300 in 60         3/3/92         AO (N type)           F-2842         25         300 in 60         3/3/92         AO (N type)           F-2842         25         300 in 14         4/3/92         567         1148         Avg           AO (N type) <td< td=""><td>0000</td><td>30</td><td>70</td><td></td><td>10/01/01</td><td>747</td><td>7/71</td><td></td><td></td></td<>	0000	30	70		10/01/01	747	7/71		
F-2835         25         70         300 in 10         25/92         AO (N type)           F-2836         25         98         300 in 60         25/92         AO (N type)           F-2836         25         91         300 in 60         25/92         AO (N type)           F-2837         25         93         300 in 75         25/92         AO (N type)           F-2838         25         65         11/8/91         AO (N type)           F-2839         25         65         11/8/91         AO (N type)           F-2840         25         96         10/30/91         AO (N type)           F-2841         25         173         10/18/91         AO (N type)           F-2842         25         300 in 60         2/21/92         AO (N type)           F-2842         25         27         10/18/91         AO (N type)           F-2842         25         300 in 60         3/27/92         AO (O type)           AVG         300 in 60         3/27/92         AO (O type)           AVG         300 in 74         4/3/92         567         1148         AVG	91-FOSF 2833	80 80	Insoluble		16/01/01				
F-2836         25         98         300 in 60         25/92         AO (N type).           F-2837         25         91         12/16/91         AO (N type).           F-2838         25         93         300 in 75         25/92         AO (N type).           F-2839         25         65         11/8/91         AO (N type).           F-2840         25         98         10/30/91         AO (N type).           F-2841         25         173         10/18/91         AO (N type).           F-2842         25         173         10/18/91         AO (N type).           F-2842         26         27         300 in 60         2/21/92         AO (N type).           F-2842         26         27         10/18/91         1162         12/7/92         AO (O type).           F-2842         26         27         300 in 60         3/27/92         787         1134         Avg.           F-2842         26         300 in 74         4/3/92         567         1148         Avg.	91-POSE-2835	25	70	300 in	2/2/82				
F-2837     25     91     12/16/91     AO (N type).       F-2838     25     93     300 in 30     2/5/92     AO (N type).       F-2839     25     65     11/8/91     AO (N type).       F-2840     25     98     10/30/91     AO (N type).       F-2841     25     1773     10/18/91     AO (N type).       F-2842     26     37     10/18/91     AO (N type).       F-2842     26     3 in 300 in 60     2/21/92     AO (N type).       F-2842     25     3 in 300     3/27/92     AO (N type).       F-2842     25     3 in 300     3/27/92     AO (N type).       Avg: 34     Avg: 34     1148     Avg.	91-POSF-2836	52	86	300 in 60	2/5/92				
F-2838     25     93     300 in 75     2/5/92     AO (N type).       F-2839     25     65     11/8/91     AO (N type).       F-2840     25     98     10/30/91     AO (N type).       F-2841     25     173     10/18/91     AO (N type).       F-2842     25     27     10/18/91     AO (N type).       F-2842     26     27     10/18/91     347     1162     12/7/92       F-2842     25     300 in 60     3/27/92     787     1134     AO (O type).       F-2842     50     3 in 300     3/27/92     787     1134     Avg.       F-2842     50     3 in 300     3/27/92     787     1148     Avg.       F-2842     50     3 in 300     3/27/92     567     1148     Avg.	91-POSF-2837	52	91		12/16/91				
F-2839       85       300 in 75       2/5/92       AO (N type).         F-2840       25       65       11/6/91       AO (N type).         F-2841       25       173       10/30/91       AO (N type).         F-2842       25       173       10/18/91       AO (N type).         F-2842       25       27       10/18/91       AO (O type).         F-2842       25       27       10/18/91       AO (O type).         F-2842       25       300 in 14       4/3/92       787       1134       AVg.         Avg. 34	91-POSF-2838	25	93	300 in 30	2/5/92				
F-2839         25         65         11/8/91         AO (N type)           F-2840         25         173         10/30/91         AO (N type)           F-2841         25         173         10/18/91         AO (N type)           F-2842         25         27         10/18/91         347         1162         127/92         AO (O type)           F-2842         25         27         10/18/91         347         1162         127/92         AO (O type)           F-2842         50         3 in 300         3/27/92         787         1134         Avg.           Avg. 34         Avg. 34         4/3/92         567         1148         Avg.	Repeat		85	300 in 75	2/2/92				
F-2840         25         173         10/30/91         AO (N type)           F-2841         25         173         10/18/91         AO (NO type)           F-2842         25         27         10/18/91         347         1162         127/92         AO (O type)           F-2842         25         27         10/18/91         347         1162         127/92         AO (O type)           F-2842         50         3 in 300         3/27/92         787         1134         AO (O type)           F-2842         25         300 in 14         4/3/92         567         1148         Avg.	91-POSF-2839	25	65		11/8/91				
F-2841         25         173         10/18/91         AO (N/O type).           F-2842         25         27         3/3/92         A7         1162         12/7/92         AO (O type).           F-2842         25         27         10/18/91         3/3/92         A7         1162         12/7/92         AO (O type).           F-2842         50         3 in 300         3/27/92         787         1134         Avg.           Avg: 34         Avg: 34         Avg: 34         Avg.         Avg.         Avg.         Avg.	91-POSF-2840	25	88		10/30/91				
F-2842 25 27 10/18/91 347 1162 12/7/92 AO (O type).  50 3 in 300 3/27/92 787 1134 Avg.  Avg: 34 Avg. 35	91-POSF-2841	25	173		10/18/91				6
F-2842 25 27 10/18/91 347 1162 12/7/92 AO (O type).  50 3 in 300 3/27/92 787 1134 Avg.  25 300 in 14 4/3/92 567 1148 Avg.	Repeat		64	300 in 60	2/21/92				
F-2842 25 27 10/18/91 347 1162 12/7/92 AO (O type).  50 3 in 300 3/27/92 787 1134 25 300 in 14 4/3/92 567 1148 Avg.  Avg: 34 Avg.	Repeat		64	300 in 60	3/3/92				
50 3 in 300 3/27/92 787 1134 Avg. 34 A	91-POSF-2842	25	27		10/18/91	347	1162	12/7/92	- 1
Avg. 34 Avg. 567 1148 Avg.			20	3 in 300	3/27/92	787	1134		
Avg: 34			52	300 in	4/3/92	267	1148	Avg.	
CONTRACTOR			Avg: 34						and the second s
	0700 1000	0		000	200	567	4000	44/4/02	AO (O time)

APPENDIX A: APPA\_FIN.XLS

			V 30 17	NO ICO	TTECTO	UI DE ANID ICOT TECT DECI II TE		
						2		CO (70 C) POSITION
			HLPS			COT		
POSF	Conc.	Carbon	ΔР	Burn Off	Blower Tube	Filter Carbon	Burn Off	
Number	mg/L	ug/cm2	mm Hg/Min.	Date	Carbon, ug	ğ	Date	Description / Supplier Recommended Dosege, mg/L
					482	1256		
					611	1126		
					550	1198		
					223	1166	Avg	
								1
91-POSF-2844	25	22		11/25/91	2470	932	11/4/92	AO (O type). Phenol
					2476	1230		
					2549	096		
					2673	914		
					2542	1009	Avg	
91-POSF-2845	100	73	1 in 300	8/3/92	531	1999	10/19/92	Low MW detergent + high MW N2 dispersant + AO & sol.
					582	2087		
					464	1868		
:					486	1748		
					516	1925	Avg	
91-POSF-2846	100	75		10/10/91	468	2105	10/20/92	Low MW detergent + high MW N2 dispersant + AO & sol.
					652	2073		
					693	2140		
					605	2097		
					909	2104	Avg	
91-POSF-2847	5	8	0 in 300	8/3/92	552	2225	10/20/92	Low MW deterg. + high MW N2 dtsp. + AO & sol. oil.
					326*	1393		
					750	1687		<ul> <li>Deposit 'ring' came off blower tube and onto filter during</li> </ul>
					559	1765		hexane rinse.
					547	1768	Avg	
91-POSF-2848	100	272	0 in 300	8/3/92	416	1590	12/7/92	Low MW deterg. + high MW N2 disp. + AO & solvent.
					519	1754		
					468	1672	Avg.	
91-POSF-2849	100	72	0 in 300	8/3/92	189	1071	12/7/92	Low MW deterg. + high MW N2 disp. + AO & solvent.
					260	1842		
					225	1457	Avg.	

APPENDIX A: APPA\_FIN.XLS

POSF			מרגט או	7010	I LESI H	HLPS AND ICOT TEST RESULTS		Revised 12/02/93
PosF								
POSF			HLPS			ICOT		
	Conc.	Carbon	dδ	Burn Off	Blower Tube	Blower Tube Filter Carbon	Burn Off	
Number	mg/L	ug/cm2	mm Hg/Min.	Date	Carbon, ug	Б'n	Date	Description / Supplier Recommended Dosage, mg/L
POSE No	100	9	300 in 100	6/2/93				30% 2 2-Bypridyl 60% 1-Mathyl-2 Pyrrolidinone &
								10% Dipropylene Glycol
90-POSF-2759	1000	1404	18 in 300	5/29/92				Disp. 1-Hydroxyethyl-2-heptadecenyl imidazoline. 1000 mg/L.
90-POSF-2785	25	141		7/15/91				Deterg. / Disp. Alkylphenol/formaldehyde resin/ aromatic
91-POSF-2850	20	227		10/10/91				naphtha and large chain alkyiphenol/naphthalene/trimethyl-
	80	53		7/15/91				benzene. / 80 mg/L.
		130*	(Flow slowed	8/14/91		:		
		106*	- cause unk.)	8/14/91				
								- 1
90-POSF-2766	25	88		12/16/91				AO (O type). MOBILAD C145, Alkyl phenol / 25 mg/L.
90-POSF-2767	25	63		10/18/91				AO (n type). MOBILAD C146, Aryl Amine. / 50 mg/L.
90-POSF-2726	1000	142		6/15/91				Detergent / Dispersant. Proprietary. 1500 mg/l.
90-POSF-2760	25	69		10/18/91				AO (O type). Alkyl phenol / 25 mg/L.
						-		
90-POSF-2727	300	342	300 in 270	7/10/92	IGNITED	2742		Detergent. Proprietary / 1500 mg/L.
					104	3010		
					130	3012		
					104	3011		
					113	2944	Avg	
		38,		101210				
90-POSF-2761	S	8		16//1/9				AC (N type). Any amine / So mg/L.
90-FOSF-2762	8	22	300 in 145	12/10/02				
921 031 E330	300	32	5 in 300	7/10/92	641	644	1/11/93	12
	က	54	0 in 300	8/14/92	1260	663		
					951	654	Avg	
	300				213	347	2/22/93	Ref. Fuel Drum #3 fuel used.
					276	448		
					245	398	Avg.	
Repeat ICOT using mass flow controller								
	300				1220	467	5/25/93	
					1200	295		
					1210	381	Avg	

			HLPS A	ND ICO	HLPS AND ICOT TEST RESULTS	ESULTS		Revised 12/02/93
			HLPS			ICOT		
POSF	Conc.	Carbon	d۷	Burn Off	Blower Tube	Blower Tube Filter Carbon	Burn Off	
Number	mg/L	ug/cm2	mr. Hg/Min.	Date	Carbon, ug	бn	Date	Description / Supplier Recommended Dosage, mg/L
92-POSF-2939	900	14	300 in 153	12/10/92	479	868	12/8/92	Experimental, Ether Ester / 570 to 856 mg/L (Clog Buster)
					531	850		
					505	874	Avg.	
		ţ		10,00,01	907	370	007400	- 1
90-POSF-2763	S2	%		10/30/91	403	640	2/24/93	AU (U type). Ayt prendt / 25 mg/L.
Repeat	25	72	300 in 210	8/3/92	352	639		
					378	742	Avg.	
93-POSF-2970	25	20	300 in 120	3/12/93	1376	1235	5/24/93	Experimental alkyłated phenol
					1606	966		
					1491	1101	Avg.	
93-POSF-2971	25	8	300 in 60	3/12/93	396	1771	5/24/93	Experimental alkylated phenoi
					305	1710		
					351	1744	Avg.	
90-POSF-2734	300	61	120 in 300	7/10/92				Detergent, Proprietary / 1500 mg/L.
90-POSF-2764	25	91		12/16/91				AO (N type). Aryl amine / 50 mg/L.
90-POSF-2735	1000	106	300 in 60	5/29/92				Detergent, Proprietary / 1500 Mg/L.
90-POSF-2732	300	69	00E ul 2	7/10/92				Detergent, Proprietary / 1500 mg/L.
90-POSF-2765	25	101		11/8/91				AO (N type). Aryl amine / 50 mg/L.
93-POSF-2972	25	22	300 in 150,	3/12/93	448	1153	5/24/93	Experimental alkylated triazole
					459	1280		
					454	1217	Avg.	
92-POSF-2948	009	8	300 in 150	11/4/92	177	877	12/11/92	AO (O type). Alkyl Phenol / 570 to 856 mg/l.
					161	939		
					169	808	Avg.	
92-POSF-2940	009	88	1 in 300	12/10/92				- !
92-POSF-2941	009	46	5 in 300	12/10/92				AO (O type). Alkyl Phenol / 570 to 856 mg/L
92-POSF-2942	009	41	300 in 240	12/10/92				Dispersant, Ether Succinimide / 570 to 856 mg/L
92-POSF-2943	009	20	0 in 300	12/10/92				Experimental, Ether Ester / 570 to 856 mg/L (Clog Buster)
92-POSF-2944	900	52	300 in 210	12/10/92				Arylamine Ester (AO & Detergent in one molecule)600 mg/L.
92-POSF-2950	900	38	5 in 300	11/4/92	84	418	1/11/93	Arylamine Ester (AO & Detergent in one molecule)600mg/L
					113	563		

			HLPS A	ND ICO	HLPS AND ICOT TEST RESULTS	ESULTS		Revised 12/02/93
			HLPS			ICOT		
POSF	Conc.	Carbon	dδ	Burn Off	Blower Tube	Filter Carbon	Burn Off	
Number	mg/L	ug/cm2 mm Hg /	mm Hg/Min.	Date	Carbon, ug	gn	Date	Description / Supplier Recommended Dosage, mg/L
					66	491	Avg.	
Repeat	8	33	0 in 300	3/12/93	360	1900	2/24/93	Ref. Fuel Drum #3 fuel used.
					621	3000		
					491	2455	Avg.	
Hepeat ICOT using mass flow controller					000	674	COLLOS	
	200				262	612	2000	The second secon
					200	210	Ave	
					553	7*0	7	
92-POSF-2945	009	89	0 in 300	12/10/92				Dispersant, Ester / 570 to 856 mg/L
92-POSF-2949	909	33	4 in 300	11/4/92	112	1550	12/10/92	
					106	1090		
					109	1320	Avg.	
92-POSF-2946	009	51	0 in 300	12/10/92				Dispersant, Ester / 570 to 856 mg/L
92-POSF-2947	9	55	1 in 300	12/10/92				Dispersant, Ester / 570 to 856 mg/L
93-POSF-2973	300	37	300 in 105	3/12/93	3598	1447	5/24/93	Alkylated Triazole
					2423	1465		
					3011	1456	Avg.	
00 BOOF 0074	ac .	97	000 ai 000	2/12/03	9000	1300	50463	Alludated Dhamal
#/67-L20 L-26	3	₽	731 11 000	200	2352	1374	0000	
					2624	1387	Avg.	
								- 1
93-POSF-2969	25	67	12 in 300	6/16/93	1010	1350	6/2/93	AO, N Type) Alkylated naphthylamine (NEW 4/93)
					•	1240		* Tube shattered when cut.
						1295	Avg.	
Repeat with new mass flow controller								
					1160	1290	6/16/93	
					1280	903		
					1220	1097	Avg.	
			300	000011		00,7	0000	
90-POSF-2730	300	\$ 1	4 In 300	28/01//	50	4183	1/12/93	Detergents, Proprietary / 1500 mg/L.
	- 5	25	1 10 300	8/14/92	391	3692	1	The second secon
				]	388	1	AVG	

HLPS AND ICO   IES  HESULIS   HEPOTICO   IES  HESULIS		LEST HEST   LEST HEST   LEST   HEST   HEST   HEST   HEST   LEST   LEST   LEST   HEST   LEST   HEST   LEST   HEST   LEST   LEST   LEST   LEST   HEST   LEST   LEST		Burn Off Date 2/22/93 Avg.	Revised 12/02/93  Description / Supplier Recommended Dosage, mg/L.  Detergents, Proprietary / 1500 mg/L.  Detergents, Proprietary / 1500 mg/L.
POSF         Conc.         Carbon AP Burn Off Logon AP Burn Off Logon AP Burn Off Logon AP Burn Off Apple App	S Burn Off Min. Date Min. Date No. 7/10/92			Burn Off Date 2/22/93 Avg.	Detergents, Proprietary / 1500 mg/L.  Detergents, Proprietary / 1500 mg/L.  Detergents, Proprietary / 1500 mg/L.
POSF         Conc.         Carbon         AP         Burn Off           Number         mg/L         ug/cm2 mm Hg / Min.         Date           Number         mg/L         ug/cm2 mm Hg / Min.         Date           F-2729         300         386         2 in 300         3710/92           F-2731         300         46         Line clogged         7/10/92           F-2729         300         82         1 in 300         8/14/92           F-2729         300         88         5 in 300         7/10/92           F-2789         25         24         300 in 60         8/26/92           F-2789         100         58         300 in 73         10/5/92           F-2789         100         66         8/14/91           F-2789         100         66         8/14/91           F-2789         100         56         300 in 300         8/3/92           F-2770         10         66         8/14/91           F-2771         11         101         8/26/91           F-2772         25         53         300 in 210         8/25/92	Min. Date Min. Date Min. Date  Min. Date  7/10/92 00 8/14/92 00 7/10/92 00 7/10/92 00 8/25/92 10/5/92 45 10/5/92			Burn Off Date 2/22/93 4vg.	Description / Supplier Recommended Dosage, mg/L.  Detergents, Proprietary / 1500 mg/L.  Detergents, Proprietary / 1500 mg/L.
POSF         Conc.         Carbon         ΔP         Burn Off           Number         mg/L         ug/cm2         mm Hg / Min.         Date           F-2729         300         386         2 in 300         3710/92           F-2729         300         46         Line clogged         7710/92           F-2729         300         82         1 in 300         81/4/92           F-2789         25         24         300 in 60         8/25/92           F-2789         100         66         8/14/91           F-2770         10         66         8/14/91           F-2771         11         101         8/26/91           F-2772         25	Min. Date Min. Date Min. Date  7/10/92 00 8/14/92 00 8/14/92 00 7/10/92 00 7/10/92 00 7/10/92 01 7/10/92 01 7/10/92			Burn Off Date 2/22/93 Avg.	Description / Supplier Recommended Dosage, mg/L Detergents, Proprietary / 1500 mg/L. Detergents, Proprietary / 1500 mg/L. Detergents, Proprietary / 1500 mg/L.
Number         mg/L         ug/om2         mm Hg / Min.         Date           F-2729         300         386         2 in 300         7/10/92           F-2729         300         367         6 in 300         8/14/92           F-2731         300         46         Line clogged         7/10/92           F-2738         300         88         5 in 300         7/10/92           F-2789         25         24         300 in 60         8/25/92           F-2789         100         58         300 in 45         10/5/92           F-2769         100         66         8/14/91         10/5/92           F-2770         100         66         300 in 45         10/5/92           F-2778         100         56         300 in 30         8/26/91           F-2771         11         101         8/26/91           F-2772         25         53         300 in 210         8/26/91           F-2772         25         53         300 in 210         8/26/91           F-2772         25         53         300 in 210         8/26/91	Min. Date  No. 7/10/92  No. 8/14/92  No. 8/14/92  No. 7/10/92	253 224 289 289 670 772		Date 2/22/93 Avg. 12/10/92	Description / Supplier Recommended Dosage, mg/L Detergents, Proprietary / 1500 mg/L. Detergents, Proprietary / 1500 mg/L.
F-2729     300     386     2 in 300       F-2729     300     367     6 in 300       F-2731     300     46     Line clogged       F-2728     300     46     Line clogged       F-2729     300     88     5 in 300       F-2789     25     24     300 in 60       F-2769     100     58     300 in 73       F-2770     100     66     300 in 45       F-2770     100     66     300 in 300       F-2771     11     101     70       F-2772     25     53     300 in 210		253 324 289 670 670 772		2/22/93 Avg. 12/10/92	Detergents, Proprietary / 1500 mg/L. Detergents, Proprietary / 1500 mg/L. Detergents, Proprietary / 1500 mg/L.
F-2729     300     386     2 in 300       F-2729     300     36     Line clogged       F-2731     300     46     Line clogged       F-2728     300     88     5 in 300       F-2729     300     88     5 in 300       F-2789     25     24     300 in 60       F-2769     100     58     300 in 73       F-2769     100     66     300 in 73       F-2770     100     66     300 in 300       F-2771     11     101     70       F-2772     25     53     300 in 210       F-2772     25     53     300 in 210		253 324 289 289 670 772		2/22/93 Avg. 12/10/92	Detergents, Proprietary / 1500 mg/L. Detergents, Proprietary / 1500 mg/L. Detergents, Proprietary / 1500 mg/L.
F-2729     300     386     2 in 300       F-2731     300     367     6 in 300       F-2731     300     46     Line clogged       F-2728     300     88     5 in 300       F-2728     300     88     5 in 300       F-2789     25     24     300 in 73       F-2769     100     58     300 in 73       F-2769     100     66     300 in 73       F-2770     100     66     300 in 300       F-2771     11     101       F-2772     25     53     300 in 210       F-2772     25     53     300 in 210		324 289 289 670 772		4vg. 12/10/92	Detergents, Proprietary / 1500 mg/L. Detergents, Proprietary / 1500 mg/L. Detergents, Proprietary / 1500 mg/L.
F-2729     300     386     2 in 300       F-2731     300     367     6 in 300       F-2728     300     46     Line clogged       F-2728     300     88     5 in 300       F-2729     25     24     300 in 60       F-2769     100     58     300 in 73       F-2769     100     66     300 in 73       F-2770     100     66     300 in 300       F-2771     11     101     70       F-2772     25     53     300 in 210		289 670 772 721		4vg.	Detergents, Proprietary / 1500 mg/L. Detergents, Proprietary / 1500 mg/L. Detergents, Proprietary / 1500 mg/L.
F-2729     300     386     2 in 300       300     367     6 in 300       F-2731     300     46     Line clogged       F-2728     300     82     1 in 300       F-2729     300     88     5 in 300       F-2789     25     24     300 in 60       F-2769     100     58     300 in 73       F-2770     100     66     300 in 45       F-2770     100     66     300 in 300       F-2771     11     101     70       F-2772     25     53     300 in 210       F-2772     25     53     300 in 210		670 772 721		12/10/92	Detergents, Proprietary / 1500 mg/L.  Detergents, Proprietary / 1500 mg/L.  Detergents, Proprietary / 1500 mg/L.
F-2731     300     367     6 in 300       F-2731     300     46     Line clogged       F-2728     300     88     1 in 300       F-2728     300     88     5 in 300       F-2769     25     24     300 in 60       F-2769     100     58     300 in 73       F-2770     100     66     300 in 45       F-2778     100     56     300 in 300       F-2771     11     101     70       F-2772     25     53     300 in 210		670 772 721		12/10/92	Detergents, Proprietary / 1500 mg/L. Detergents, Proprietary / 1500 mg/L.
F-2731     300     46     Line clogged       300     82     1 in 300       F-2728     300     88     5 in 300       F-2789     25     24     300 in 60       F-2768     100     58     300 in 73       F-2769     100     66     300 in 45       F-2770     100     66     300 in 300       F-2788     100     56     300 in 300       F-2771     11     101     70       F-2772     25     53     300 in 210		670 772 721		12/10/92	Detergents, Proprietary / 1500 mg/L. Detergents, Proprietary / 1500 mg/L.
F-2728     300     82     1 in 300       F-2728     300     88     5 in 300       F-2769     25     24     300 in 60       F-2769     100     58     300 in 73       F-2770     100     66     300 in 45       F-2770     100     66     300 in 300       F-2771     11     101     70       F-2772     25     53     300 in 210		670 772 721		12/10/92	Detergents, Proprietary / 1500 mg/L.
F-2728     300     88     5 in 300       F-2789     25     24     300 in 80       F-2768     100     58     300 in 73       F-2769     100     46     300 in 45       F-2770     100     66     300 in 300       F-2778     100     56     300 in 300       F-2771     11     101     70       F-2772     25     53     300 in 210	80 80 45	670 772 721		12/10/92	Detergents, Proprietary / 1500 mg/L.
25 24 300 in 60 100 58 300 in 73 100 46 300 in 45 100 66 300 in 300 100 56 300 in 300 111 101 70	80 83	670 772 721		12/10/92	
100 58 300 in 73 100 46 300 in 45 100 66 300 in 300 100 56 300 in 300 101 11 101	60 60	772		12/10/92	
100 58 300 in 73 100 46 300 in 45 100 66 300 in 300 100 56 300 in 300 111 101 70 70	73	721	П	4.12	AO/Disp./Stab. Amine substituted resin + aliphatic
100 58 300 in 73 100 46 300 in 45 100 66 300 in 300 100 56 300 in 300 111 101 70 70	73	721	T		amine. / 85 - 130 mg/L.
100 58 300 in 73 100 46 300 in 45 100 66 300 in 300 100 58 300 in 300 111 101 25 53 300 in 210	£ 73		_	AVG.	
100 46 300 in 45 100 66 300 in 300 100 58 300 in 300 11 101 101 25 53 300 in 210	$\dashv$				Antifoulant. An alkyt aryl diamine. / 100 mg/L.
100 66 300 in 300 100 56 300 in 300 11 101 25 53 300 in 210		873	559	1/11/93	Antifoul. An alkyl aryl diamine in heavy aro. naphtha. / 100
100 66 300 in 300 100 56 300 in 300 11 101 25 53 300 in 210		629	498		
100 66 300 in 300 100 56 300 in 300 11 101 25 53 300 in 210		726	529	Avg.	
100 56 300 in 300 11 101 70 70 25 53 300 in 210	8/14/91				Antifoulant. Substituted amines & butylcatechol in DMF. /100
11 101 70 70 25 53 300 in 210		440	2688	2/22/93	Stabilizer. Amine substituted resin. / 85-130 mg/L.
11 101 70 70 25 53 300 in 210		542	2602		
11 101 70 70 25 53 300 in 210		491	2645	Avg.	
11 101 70 70 25 53 300 in 210					
25 53 300 in 210	8/26/91				AO/ disp. Anhydride / polyamine product + solv. 12mg/L.
25 53 300 in 210	$\dashv$				
	-	734	652	2/22/93	AO / Disp. Imide & acrylate polymer in aro/alcohol. 12mg/L
		867			
		801	732	Avg.	
	+				
90-POSF-2773 25 45 0 in 300 8/14/92	4	629	412	1/11/93	AO / Disp. Amine and acrylic polymers in aro/aliph sol. 12
		782	920		
		721	/ 999	Avg.	
90-POSF-2774 12 262 6/17/91	6/17/91				AO/Disp./MDA. Amino alkylphenolic resins, amine aldehyde
Drum #2 38 300 in 63 10/15/92	83				condensate + solvent, 12 mg/L.
-2775	9/11/91				AO/Disp./MDA. Amino alkylphenolic resins, aminealdehyde
117 9/11/91	9/11/91				condensate + solvent. 12 mg/L.
90-POSF-2776 12 144 6/15/91	6/15/91				AO/Disp./MDA. Amino alkylphenolic resins, alicyclic

APPENDIX A: APPA\_FIN.XLS

POSF   Conc. Carico   AP   Bun Off   Blower Tube Filter Carbon   Bun Off   Buner Tube Filter Carbon   Bun Off   Bun Off   Buner Tube Filter Carbon   Buner Tube Filter Carbon   Bun Off   Buner Tube Filter Carbon   Buner Tube Filter Carbon   Buner Tube Filter Carbon   Bun Off   Buner Tube Filter Carbon   B				HLPS AI	VD ICO	S AND ICOT TEST RESULTS	ESULTS		Revised 12/02/93
POSF         Conc.         Carbon         AP         Burn Off         Blower Tube Filter Carbon         Burn Off         Blower Tube Filter Carbon         Burn Off         Bu									
POSF         Conc         Carbon         AP         Burn OH         Blower Tube         Filler Carbon         Burn OH         Blower Tube         Filler Carbon         Burn OH				HLPS			ICOT		
Number         mg/L         ug/cmm         mm Hg / Min         Dale         Casbon, ug         ug         Date           25         26         300 in 12         9125/92         561         1119         126/92         AOD           25         26         300 in 12         9125/92         561         1119         126/92         AOD           25         32         300 in 56         8125/92         611         847         1210/92         AOD           25         40         4 in 300         4729/3         1271         AVG         Avg         Avg           1000         25         40         4 in 300         4729/3         1271         Avg         Avg           300         51         23 in 300         5729/92         177         467         Avg         Disp.           300         51         23 in 300         6726/92         117         467         222/93         Disp.           300         51         23 in 300         6726/92         117         467         Avg         Disp.           1000         218         300 in 120         6729/92         340         494         Avg         Disp.           1000         228 <th>POSF</th> <th>Conc.</th> <th>Carbon</th> <th>ďδ</th> <th>Burn Off</th> <th>Blower Tube</th> <th>Filter Carbon</th> <th>Burn Off</th> <th></th>	POSF	Conc.	Carbon	ďδ	Burn Off	Blower Tube	Filter Carbon	Burn Off	
25   25   300 in 12   8125/92   561   1118   1129/92   AO/DI	Number	mg/L	ug/cm2	mm Hg/Min.	Date	Carbon, ug	Бn	Date	Description / Supplier Recommended Dosage, mg/L
25   25   300 in 12   8125/92   561   1118   12/8/92   Annino     25   32   300 in 56   8125/92   6111   847   12/10/92   Annino     25   32   300 in 56   8125/92   6111   847   12/10/92   Annino     25   40   4 in 300   412/83   122/1   1672   5/24/93   Experimentation     26   40   4 in 300   412/83   122/1   1672   5/24/93   Experimentation     26   40   4 in 300   676/82   122/1   1672   5/24/93   Experimentation     26   40   4 in 300   6726/92   127/1   167/2   5/24/93   Experimentation     26   40   4 in 300   6726/92   127/1   467   2/22/93   Experimentation     27   27   27   27   27   27   27								-	
25   25   300 in 12   8125/92   561   1118   12/9/92   AO/DI									amine / 12 mg/L
100   100	90-POSF-2777	52	25	300 in 12	8/25/92	561	1118	12/9/92	AO/Disp./MDA. Amino alkylphenolic resins, ethylene
1000   218   300 in 56   8125/92   611   847   12/10/92   A0/10/10     25						763	1289		diamine. / 12 mg/L.
1000   25   32   300 in 56   8/25/92   611   847   12/10/92   AOIDI     25   40   4 in 300   4/2/93   1271   1672   5/24/93   5/94     1000   51   22 in 300   5/26/92   117   467   2/22/93     1000   51   22 in 300   5/26/92   117   467   2/22/93     1000   51   22 in 300   6/26/92   117   467   2/22/93     1000   28   300 in 182   5/28/92   320   12/8/92   11/8/92     1000   28   300 in 180   5/28/92   320   12/8/92   11/8/92     1000   28   300 in 180   5/28/92   320   12/8/92   11/8/92     1000   29   300 in 120   5/28/92   320   11/8   5/24/93   5/24/93     25   44   7 in 300   3/12/93   1998   1181   5/24/93   5/24/93     25   128   300 in 240   4/2/93   4/2/93   1998   1181   5/24/93     25   128   300 in 240   4/2/93   4/2/93   1998   1181   5/24/93     26   44   7 in 300   3/12/93   4/2/93   1998   1181   5/24/93     26   44   7 in 300   3/12/93   4/2/93   1998   1181   5/24/93     26   44   7 in 300   3/12/93   4/2/93   1998   1/2/93     27   28   28   28   28   28   28     28   28						662	1204	Avg	
25   32   300 in 56   6126/92   611   847   12/10/92   AO/DI									- 1
September   Sept	90-POSF-2778	25	8	300 in 56	8/25/92	611	847	12/10/92	!
1000   25   40   4 in 300   4 i						576	646		derivatives. / 12 mg/L.
sing mass flow controller         25         40         4 in 300         4/2/93         1271         1672         5/24/93         Experient left           sing mass flow controller         1000         51         23 in 300         5/29/92         117         467         2/22/93         Disposition left           sing mass flow controller         300         218         300 in 182         5/29/92         103         3580         5/25/93         Disposition left         Avg						594	747	Avg.	
25									
1295   1653   Avg.   Disp.   1287   1663   Avg.   Disp.   Di	93-POSF-2968	25	9	4 in 300	4/2/93	1271	1672	5/24/93	Experimental dispersant
1000   51   23 in 300   5729/92   1.7   467   2722/93   1.8   1.						1295	1653		
sing mass flow controller         51         23 in 300         5/29/92         117         467         2/22/93         Olsp.           sing mass flow controller         300         93         4 in 300         6/26/92         117         469         Avg.         Avg.         Avg.         Avg.         Avg.         Avg.         Avg.         Dispension of the controller         100         22 (7)         469         Avg.         Avg.         Avg.         Avg.         Avg.         Avg.         Avg.         Dispension of the controller         1000         218         300 in 182         5/28/92         334         482         Avg.         Dispension of the controller         Avg.         Avg.         Dispension of the controller         Avg.         Av						1283	1663	Avg.	
sing mass flow controller         300         93         4 in 300         6/26/92         117         467         2/22/93         471           sling mass flow controller         300         1         469         409         409         409         409         5/26/93	90-POSF-2737	1000	5	23 in 300	5/29/92				Disp. Anhydride polyamine reaction product in sol. 1000 mg/L.
sing mass flow controller  300  22 (?) 471  469  Avg.  103  3580  5726/33  103  3580  5726/33  100  4060  100  218  300 in 182  5729/92  346  482  346  482  346  482  346  482  347  482  346  348  349  484  Avg.  5724/33  5724/3		900 300	83	4 in 300	6/26/92	117	467	2/22/93	
sing mass flow controller     300     103     3580     5/25/93       100     218     300 in 182     5/29/92     100     4060     6/25/93       1000     218     300 in 162     5/29/92     334     505     12/892     Disp.       1000     28     300 in 150     8/14/92     346     494     Avg.     Disp.       1000     93     300 in 120     5/29/92     366     12/4     Avg.     Exper       25     44     7 in 300     3/12/93     1392     1181     5/24/93     Exper       25     128     300 in 240     4/2/93     459     1214     Avg.       25     128     300 in 240     4/2/93     459     1083     5/24/93     Exper       25     128     300 in 240     4/2/93     459     1083     5/24/93     Exper       26     128     300 in 240     4/2/93     459     1093     5/24/93     Exper						22 (?)	471		
sing mass flow controller     300     103     3580     5/25/93       100     4060     4060     5/25/93       100     218     300 in 182     5/29/92     100     4060       1000     28     300 in 180     5/29/92     345     482     Disp.       300     28     300 in 150     8/14/92     334     505     12/8/92     Disp.       1000     93     300 in 120     5/29/92     340     494     Avg.     Disp.       300     20     5 in 300     4/2/93     320     1161     5/24/93     Exper       25     44     7 in 300     3/12/93     1996     1181     5/24/93     Exper       25     128     300 in 240     4/2/93     459     1083     5/24/93     Exper       25     128     300 in 240     4/2/93     459     100     4/2							469	Avg.	
300     100     4060     5/25/93       1000     218     300 in 182     5/29/92     4060     Avg.       1000     28     300 in 150     8/14/92     334     505     12/6/92     Dispansion 12/6/92       1000     93     300 in 120     5/29/92     340     494     Avg.     Dispansion 12/6/92     340     494     Avg.     Dispansion 12/6/92       300     20     5 in 300     4/2/93     320     1268     5/24/93     Experimental E	Repeat ICOT using mass flow controller								
1000 218 300 in 182 5/29/92 334 505 12/8/92 Dispension of the control of the cont						103	3580	5/25/93	
1000 218 300 in 182 5/29/92 334 505 1/28/92 Disp. 340 28 300 in 150 8/14/92 334 505 1/28/92 Disp. 340 494 482 Disp. 340 409. 340 409. 350 20 5 in 300 4/2/93 320 1/28 5/24/93 Exper 300 20 5 in 300 4/2/93 392 1/28 5/24/93 Exper 300 in 20 3/12/93 1998 1/2/4 Avg. 25 44 7 in 300 3/12/93 1998 1/2/4 Avg. 25 1/28 300 in 240 4/2/93 455 1/2/4 Avg. 25 1/28 300 in 240 4/2/93 455 1/100 Avg.						5	4060		
1000     218     300 in 182     5/29/92     334     505     12/8/92     Disp.       300     28     300 in 150     8/14/92     334     505     12/8/92     Disp.       1000     93     300 in 120     5/29/92     320     1268     5/24/93     Exper       20     5 in 300     4/2/93     320     1268     5/24/93     Exper       25     44     7 in 300     3/12/93     1998     1181     5/24/93     Exper       25     128     300 in 240     4/2/93     459     1083     5/24/93     Exper       25     128     300 in 240     4/2/93     459     1083     5/24/93     Exper						102	3820	Avg	
300         28         300 in 150         8/14/92         334         505         12/8/92         Disp.           34         482         346         482         482         482         12/8/92         12/8/9         11/17         4/8/9         11/17         11/17         11/17         11/17         11/17         11/17         11/17         11/17         11/17         11/17         11/17         11/10         11/1	90-POSF-2738	1000	218	300 in 182	5/29/92				Dispersant. Anhydride/polyamine reaction products in sol.
346     482       340     494     Avg.       1000     93     300 in 120     5/29/92     0158.       300     20     5 in 300     4/2/93     320     1268     5/24/93     Experior       25     44     7 in 300     3/12/93     1998     1181     5/24/93     Experior       25     128     300 in 240     4/2/93     459     1083     5/24/93     Experior       25     128     300 in 240     4/2/93     459     1083     5/24/93     Experior	90-POSF-2739	300	28		8/14/92	334	505	12/8/92	Disp. Hi MW imide/aminoalkylphenolic resin/acrylic polymer
1000         93         300 in 120         5/29/92         Avg.         Disp.           300         20         5 in 300         4/2/93         320         1268         5/24/93         Experimental Responsible Property of the						345	482		
1000         93         300 in 120         5/29/92         1268         5/24/93         Experimentation           300         20         5 in 300         4/2/93         320         1268         5/24/93         Experimentation           25         44         7 in 300         3/12/93         1998         1181         5/24/93         Experimentation           25         128         300 in 240         4/2/93         459         1083         5/24/93         Experimentation           25         128         300 in 240         4/2/93         459         1083         5/24/93         Experimentation           455         1117         456         1100         440						340	494	Avg.	
300         20         5 in 300         4/2/93         320         1268         5/24/93           392         1160         392         1160         40 <td< td=""><td>90-POSF-2736</td><td>1000</td><td>အ</td><td>300 in 120</td><td>5/29/92</td><td></td><td></td><td></td><td>Disp. Alkylaryl sulfonates in aromatic solvent. / 1000 mg/L.</td></td<>	90-POSF-2736	1000	အ	300 in 120	5/29/92				Disp. Alkylaryl sulfonates in aromatic solvent. / 1000 mg/L.
392     1160       356     1214     Avg       25     44     7 in 300     3/12/93     1998     1181     5/24/93       1312     1247     1247     Avg       25     128     300 in 240     4/2/93     459     1083     5/24/93       25     128     300 in 240     4/2/93     459     100     Avg	93-POSF-2966	300	ୡ	5 in 300	4/2/93	320	1268	5/24/93	Experimental dispersant
25 44 7 in 300 3/12/93 1998 1181 5/24/93 1312 1247 Avg. 128 300 in 240 4/2/93 459 1083 5/24/93 25 128 300 in 240 4/2/93 459 1083 5/24/93 Avg.						392	1160		
25     44     7 in 300     3/12/93     1998     1181     5/24/93       1312     1247       1655     1214     Avg.       25     128     300 in 240     4/2/93     459     1083     5/24/93       453     1117       456     100     Avg.						356	1214	Avg	
25 44 7 in 300 3/12/93 1998 1181 5/24/93 1247 1312 1247 1247 1247 125 128 300 in 240 4/2/93 459 1083 5/24/93 1117 400									
1312 1247 1655 1214 Avg 25 128 300 in 240 4/2/93 459 1083 5/24/93 453 1117 Avg	93-POSE-2975	67	44	305 = /	3/12/93	1990	0	5/64/93	EXPERIMENTAL CONTRACTOR CONTRACTO
1655 1214 Avg 25 128 300 in 240 4/2/93 459 1083 5/24/93 453 1117 Avg						1312	1247		
25 128 300 in 240 4/2/93 459 1083 5/24/93 453 1117 456 1100 Avg						1655	1214	Avg	A CAMPAGE AND A
25 128 300 in 240 4/2/93 459 1083 5/24/93 459 1117 459 1117 Avg		,		1					The second secon
185	93-POSF-2967	25	128	300 in 240	4/2/93	459	1083	5/24/93	Experimental antifoulant
3						456		Aun	The state of the s

			HLPS A	ND ICO	HLPS AND ICOT TEST RESULTS	ESULTS		Revised 12/02/93
			HLPS			ICOT		
POSF	Conc.	Carbon	ď∇	Burn Off	Blower Tube	Filter Carbon	Burn Off	
Number	mg/L	ug/cm2 mm Hg /	mm Hg/Min.	Date	Carbon, ug	бn	Date	Description / Supplier Recommended Dosage, mg/L
					10. pl - 90. mg			
93.POSE.2947	Ç	85	300 in 110	7/14/93				Determent/corrosion inhib Fatty acid amide acid mixed
								alkyl alcohols and fatty diamines in dewaxed heavy paraffinic
								petroleum distillates.
93-POSF-2958	100	42	0 in 300	7/14/93				Detergent/corrosion inhib./demuisifier. Alkenyl succinimide
								& kerosene in dewaxed heavy paraffinic petroleum distillates.
90-POSF-2781	25	<b>%</b>		10/30/91				AO (N type). 100% N,N'-di-se⇔butyl-p-phenylenedlamine +
								solvent. / 2 - 60 mg/L.
90-POSF-2782	52	106		12/16/91				AO (N type). N-phenyl-N'-sec-butyl-p-phenylenediamine +
								solvent. / 1-40 mg/L.
90-POSF-2783	25	112		12/16/91				AO (N type). UOP No. 12P + N,N'-di-sec-butyl-o-phenylene-
								diamine + solvent. / 2 - 40 mg/L.
92-POSF-2951	25	160	1 in 300	8/25/92	115	1287	1/14/93	Dispersant. High molecular weight amine polymer / 25 mg/L
					667	1288		
					391	1288	Avg.	
	30	8	1000	0,44,60	000	0200	4/44/00	from 30 / traviles efferments at leviles estimated and O.C.
Devoot	22	414	300 in 120	8/14/02	77.4	2069	2011	
Labasi	67	2	200	201110	202	2003	Ave	
					707	1 777	Ž.	
20 BOSE 0784	30	440		10/10/01				100 (1 4.50 most partient butterbands (4.50 most
90-POSE-2780	01	27	300 in 30	4/10/92	621	873	12/9/92	MDA N.N-disalicylidene-1.2-propanediamine & solvent / 4-16
					416	875		
					519	874	Avg.	
REFERENCE FUELS								
POSF-2799, JP-TS, A F supplied			HLPS Break Point = 750°F (398.9°C)	Point = 750°	= (398.9°C)			and the second s
	1	9		9/27/91	92	586	9/1/92	
		7	1 in 300	2/21/92	61	699	10/5/92	
	Avg	7			84	474		
					84	209		
					74	584	Avg.	
					12	81	S.D.	
					16%	14%	C.V.	

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			HLPS A	ND ICO	HLPS AND ICOT TEST RESULTS	ESULTS		Revised 12/02/83
			HLPS			ICOT		
POSF	Conc.	Carbon	ΔP	Burn Off	Blower Tube	Blower Tube Filter Carbon	Burn Off	
Number	mg/L	ug/cm2	mm Hg/Min.	Date	Carbon, ug	ng	Date	Description / Supplier Recommended Dosage, mg/L
POSF-2747, Super K-1 (Highly refined)		HLPS Break Poin	ak Point = 63(	It = 630°F (332.2°C)	9)			
JFTOT Unit 654 Break Point = 610°F (321.1°C)	21.1°C)	Avg. Break Point	k Point = 620°	= 620°F (326.7°C)				
		4		•	465	1899	9/1/92	
		=		•	743	380	9/4/92	
		9	0 in 300	4/15/92	604	1139	Avg.	
	Avg:	7			197		S.D.	
					33%		C.V.	
Repeat with								
Drum#3					199	IGNITED	10/15/92	
			•		79	1254		
					51	602		
					57	985		
					97	947	Avg.	
POSF 2827, Jet A-1 Reference Fuel				HLPS Break	HLPS Break Point = 510°F (265.5°C)	(265.5°C)		
		145		6/15/91	3344	1859	9/4/92	Drum #1-HLPS / Drum #2-ICOT
		158	300 in 60	7/15/91	2806	1207	9/4/92	
	Avg:	152			4887	7936	9/1/92	
					1747	2609	9/1/92	The second secon
					830	1245	10/19/92	
					3196	2971	Avg.	
Drum #2		45	300 in 180	9/4/92				Drum #2 of POSF-2827 was received on 12/17/91.
Repeats		જ	300 in 180	9/4/92				Testing with drum #2 began in January 1992.
		72	300 in 180	9/24/92				WL Drum
	Retest	84	300 in 150	10/15/92		,		
		45	300 in 210	9/24/92				WL Tank
		97	1000	4/44/00	2000	000	CONCORC	
Drum #3		ę	300 In 45	26/4/1	/211	2001	6/66/93	

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COT   Date   D				HLPS A	VD ICO	HLPS AND ICOT TEST RESULTS	ESULTS		Revised 12/02/93
POSF   Conc.   Carbon   AP   Bun Off   Blower Tube   Filer Carbon   Bunn Off									
Posfer				HLPS			ICOT		
Number	POSF	Conc.	Carbon	ΔP		Blower Tube	Filter Carbon	Burn Off	
922, Ashland Jaf A with 15% hydrocracked slock.  928, Excon Jaf A with 15% hydrocracked slock.  929, Alaska JP-8 (JET A50: -50°F freeze pt.)  121 300 in 60 6/16839  121 3280	Number	mg/L	ug/cm2	mm H		Carbon, ug	Бn	Date	Description / Supplier Recommended Dosage, mg/L.
1036   7782   Avg									
1036   782 Avg   1036	New HLPS unit		47	300 in 210	2/10/93	945	481		
926. Shell Oil Jel A with 15% hydrocracked stock.  928. Exoon Jet A with 15% hydrocracked stock.  929. Abaka JPe (JET A50: -50°F freeze pt.)  929. Abaka JPe (JET A50: -50°F freeze pt.)  929. 1900  929. Abaka JPe (JET A50: -50°F freeze pt.)  929. 1900  929. Abaka JPe (JET A50: -50°F freeze pt.)  929. 280						1036		Avg.	
922. Ashland Jet A, mildy hydroteated Break Point: 560°F (228°C)									
922. Ashland Jef A. mildly hydrotreated Break Point on Drum 43: 640°F (282°C)	Drum #3 repeat					2441	1889	5/20/93	
922. Ashland Jet A. mildly hydrotreated Break Point: 530°F (228°C)						1654	1660		
922. Ashland Jef A, mildy hydrotreated Break Point 530°F (277°C)						2048		Avg.	
922, Ashland Jef A, mildly hydrotrealed Break Point: 530°F (277°C)	1 1								
922. Ashland Jef A, mildly hydrotreated Break Point: 530°F (277°C)	١,	40°F (282°C)							
926, Shell Oil Jet A     Break Point: 530°F (277°C)     472/93     8340     23500     5/25/93       926, Shell Oil Jet A     Break Point: 550°F (288°C)     7885     21550     Avg.       926, Shell Oil Jet A     Break Point: 550°F (288°C)     28398     IGNITED     10/15/92       928, Exxon Jet A with 15% hydrocracked slock     Break Point 535 F (288 C)     22713     1879     Avg.       938, Exxon Jet A with 15% hydrocracked slock     Break Point 535 F (288 C)     72890     4090     5/25/93       934, Aleska JP-8 (JET A50: -50°F freeze pt)     121     300 in 60     6/16/93     863     1110     2290									
926, Shell Oil Jaf A         18         6 in 300         4/2/93         8340         23500         5/25/93           926, Shell Oil Jaf A         Break Point: 550°F (288°C)         7886         1350         Avg.         Avg.           926, Shell Oil Jaf A         Break Point: 550°F (288°C)         2638         IGNITED         10/15/92           926, Shell Oil Jaf A         45         140 in 300         4/14/93         1849         IGNITED         10/15/92           928, Exxon Jef Awith 15% hydrocracked stock         81         2713         1879         Avg.         10 in 300         4/14/93         1849         IGNITED         Avg.           928, Exxon Jef Awith 15% hydrocracked stock         Break Point 535 F (288 C)         2713         1879         Avg.         10 in 300         4/14/93         1879         1000         5/25/93           928, Exxon Jef Awith 15% hydrocracked stock         Break Point 535 F (288 C)         7290         4090         5/25/93         1000         4/293         1000         4/293         1000         4/293         1000         4/293         1000         4/293         1000         4/293         1000         6/16/93         1110         2290         6/16/93         1100         2200         1100         1100         1110	POSF 2922, Ashland Jet A, mildly hydrot	treated	<b>Break Pol</b>	nt: 530°F (27	7°C)				
926, Shell Oil Jet A Break Point 550°F (288°C)			18	6 in 300	4/2/93	8340	23500	5/25/93	
926, Shell Oil Jet A Break Point: 550°F (288°C)						7390	19600		
926. Shell Oil Jet A  Break Point: 550°F (288°C)  24 5 in 300 8/392 2638 IGNITED 10/15/92  45 140 in 300 4/12/93 3066 IGNITED 10/15/92  45 140 in 300 4/12/93 3066 IGNITED 10/15/92  45 140 in 300 4/12/93 1849 IGNITED 10/15/92  22713 1879 Avg.  228. Exxon Jet A with 15% hydrocracked stock.  Break Point 53 F (288 C)  37 256 in 300 8/392 7290 4090 5/25/93  36 300 in 180 4/2/93 * 4000 5/25/93  4045 Avg.  1121 300 in 60 6/16/93 863 1950 6/16/93						7865		Avg.	
926, Shell Oil Jet A Break Point: 550°F (288°C) 2638 IGNITED 10/15/92 45 140 in 300 4/2/93 3066 IGNITED 10/15/92 45 140 in 300 4/14/93 1849 IGNITED 10/15/92 414/93 1849 IGNITED 10/15/92 414/93 1849 IGNITED 10/15/92 414/93 1849 IGNITED 10/15/92 2213 1879 Avg. 221, 32 221, 32 221, 32 221, 33 221, 34 221									
928, Shell Oil Jet A Break Point: 550°F (288°C)									
24       5 in 300       8/3/92       2638       IGNITED       10/15/92         45       140 in 300       4/14/93       3066       IGNITED       10/15/92         41       0 in 300       4/14/93       1849       IGNITED       10/11/10         41       0 in 300       4/14/93       1849       IGNITED       10/11/10         41       0 in 300       4/14/93       1821       IGNITED       1879         400       2713       1879       Avg.       Avg.         828, Exxon Jet A with 15% hydrocracked stock.       Break Point 535 F (288 C)       7290       4090       5/25/93         37       256 in 300       8/3/92       7       4000       5/25/93       Tube data missing         934, Alaska JP-6 (JET A50: -50°F freeze pt.)       121       300 in 60       6/16/93       6/16/93       6/16/93         1110       2290       1110       2290	POSF 2926, Shell Oil Jet A		<b>Break Poi</b>	nt: 550°F (28)	8°C)				
928, Exxon Jet A with 15% hydrocracked stock.  Say, Alaska JP-8 (JET A50: -50°F freeze pt.)  41			24	5 in 300	8/3/92	2638	IGNITED	10/15/92	
928, Exxon Jet A with 15% hydrocracked stock.  Sak Alaska JP-8 (JET ASO: -50°F freeze pt.)  929, Alaska JP-8 (JET ASO: -50°F freeze pt.)  929	Repeat		45	140 in 300	4/2/93	3066	IGNITED		
928, Exxon Jet A with 15% hydrocracked stock.  928, A laska JP-6 (JET A S0: -50°F freeze pt.)  934, Alaska JP-6 (JET A S0: -50°F freeze pt.)  937, A laska JP-6 (JET A S0: -50°F freeze pt.)  938, A laska JP-8 (JET A S0: -50°F freeze pt.)  939, A laska JP-8 (JET A S0: -50°F freeze pt.)  931, A laska JP-8 (JET A S0: -50°F freeze pt.)  932, A laska JP-8 (JET A S0: -50°F freeze pt.)  934, A laska JP-8 (JET A S0: -50°F freeze pt.)  935, A laska JP-8 (JET A S0: -50°F freeze pt.)  937, A laska JP-8 (JET A S0: -50°F freeze pt.)  938, A laska JP-8 (JET A S0: -50°F freeze pt.)  939, A laska JP-8 (JET A S0: -50°F freeze pt.)  939, A laska JP-8 (JET A S0: -50°F freeze pt.)  939, A laska JP-8 (JET A S0: -50°F freeze pt.)	Repeat		41	0 in 300	4/14/93	1849	IGNITED		
928, Exxon Jet A with 15% hydrocracked stock.  928, Exxon Jet A with 15% hydrocracked stock.  36 300 in 180 4/2/93 1 4045 Avg.  36 300 in 180 4/2/93 1 4045 Avg.  37 256 in 300 8/3/92 7290 4090 5/25/93 Tube data missing.  4045 Avg.  4045 Avg.  121 300 in 60 6/16/93 863 1950 6/16/93						1821	IGNITED		
928, Excon Jet A with 15% hydrocracked stock.  928, Excon Jet A with 15% hydrocracked stock.  37						2713	1879		
928, Exxon Jet A with 15% hydrocracked stock. Break Point 535 F (288 C)  37						2417		Avg.	
934. Alaska JP-8 (JET A50: -50°F freeze pt.)  121 300 in 60 6/16/93 863 1950 6/16/93	POSE 2028 Exych let A with 15% hydro	ocracked ato		Breek Point 5	35 F (288 C)				
934, Alaska JP-8 (JET A50: -50°F freeze pt.)  121 300 in 60 6/16/93 863 1950 6/16/93			37	256 in 300	8/3/92	7290	4090	5/25/93	
934, Alaska JP-8 (JET A50: -50°F freeze pt.) 121 300 in 60 6/16/93 863 1950 6/16/93 6/16/93	Repeat		98	300 in 180	4/2/93	•	4000		* Tube data missing. ?
121 300 in 60 6/16/93 863 1950 1110 2290								Avg.	
121 300 in 60 6/16/93 863 1950 1110 2290									
121 300 in 60 6/16/93 863 1950 1110 2290									
121 300 in 60 6/16/93 863 1950 1110 2290									
300 in 60 6/16/93 863 1950	POSF 2934, Alaska JP-8 (JET A50: -50°	F freeze pt.)						30000	
_	11.0		121	300 in 60	6/16/93	863	1950	6/16/93	
						1110	2290		

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			HLPS A	VD ICO	HLPS AND ICOT TEST RESULTS	ESULTS		Revised 12/02/93
			HLPS			ICOT		
POSF	Conc.	Carbon	dδ	Burn Off	Blower Tube	Filter Carbon	Burn Off	
Number	mg/L		mm Hg/Min.	Date	Carbon, ug	gn	Date	Description / Supplier Recommended Dosage, mg/L
					987	2120	Avg.	
POSF-2936, Cincinnati (high TAN)		Break Poi	Break Point: 530°F (277°C)	7°C)				
		65	300 in 215	4/15/93	2810	2800	6/2/93	
					3100	3300		
					2955	3090	Avg.	
POSF-2959, Mobil MEROX Treated		Break Poi	Break Point: 560°F (293°C)	3°C)				
		113	1 in 300	4/20/93	7580	802	5/25/93	
					(6.5)	1040		** Questionable data.
						921	Avg.	
POSF-2963, NAWC T3 Nozzel Fuel (50 ppb Cu)	opb Cu)							
		Piugged	>300 in 60	11/11/93				*The 0.45um filter at the fuel reservior exit was plugged.
Retest without reservoir filter		153	>300 in 46	12/2/93				
POSF-2976, 'New' JPTS								
		9	0 in 300	12/2/93				
POSF-2980, Marathon Oil Co. MEROX Treated	reated	Break Pol	Break Point: 550°F (288°C)	(၃)				
		25	13 in 300	11/11/93				
Mandard Control of the Allert Allert								
TOST-2505, 57-5 (night Middlen William)		101	Oc ai Oc	44/44/00				
		3	200	2011				
Candidate Additive Experimental P&W Blen	rimenta	N&Y	Blends					
POSF 2881 + 2786	25+11	6	300 in 25	4/3/92				
POSF 2881 + 2786	25+11	6	300 in 7	4/24/92				

			HLPS A	ND ICO	S AND ICOT TEST RESULTS	ESULTS		Revised 12/02/93
			HLPS			ICOT		
POSF	Conc.	Carbon	dδ	Burn Off	Blower Tube Filter Carbon	Filter Carbon	Burn Off	
Number	mg/L	ug/cm2 mm Hg	mm Hg/Min.	Date	Carbon, ug	ug	Date	Description / Supplier Recommended Dosage, mg/L
POSF 2881 + 2913	25+5	52	300 in 120	3/27/92				
POSF 2881 + 2913	25+5	=	2 in 300	4/3/92				
POSF 2881 + 2913	25+5	15	165 in 300	4/15/92				
POSF 2881 + 2913	25+5	14	300 in 75	4/24/92				
POSF 2881 + 2913	25+5	11,	6 in 300	5/29/92				* Note: Single batch of blended additives used.
POSF 2881 + 2913	25+5	19.	300 in 270	5/29/92				
POSF 2881 + 2912 **	25 + 5		300 ln 11	7/16/92				** Note: No carbon analysis based on delta P result.
POSF 2881 + 2914	25+5	54	300 in 33	6/26/92				
POSF 2881 + 2759	25+1000	1504	11 in 300	5/29/92				
POSF 2843 + 2786	25+11	16	19 in 300	1/17/92				
POSF 2843 + 2786	12+11	23	5 in 300	1/17/92				
POSF 2843 + 2914	25+5	22	300 in 240	4/24/92				
POSF 2843 + 2914	25+5	ଛ	300 in 300	8/3/92				
POSF 2843 + 2904	25+10	18	300 in 30	2/21/92				
POSF 2843 + 2904 + 2913	25+10+5	2	8 in 300	3/11/92				
POSF 2843 + 2913	25+5	27	9 in 300	3/11/92				
POSF 2843 + 2913	25+5	21	1 in 300	4/24/92				
POSF 2843 + 2913	25+5	6	4 in 300	8/3/92				
POSF 2843 + 2912	25+5	10	Line Plug	8/4/92				Flow stopped 2 hours into run - test terminated.
POSF 2843 + 2894	25+25	12	5 in 300	11/4/92				
POSF 2843 + 2730	25+5	16	5 in 300	11/4/92				
POSF 2786 + 2856	11+100	44		9/24/91				
Super K-1 + POSF 2904	10	17		11/15/91				
POSF 2851 + 2904 + 2786	23+10+11	23		11/15/91				
POSF 2894 + 2727	100+300	65	300 in 180	12/10/92	71	431	12/7/92	
					65	505		
					89	468	Avg.	
Repeat	100+300	69	4 in 300	3/12/93	250	393	2/22/93	
					317	•		* Instrument malfunction

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			HLPS A	ND ICO	HLPS AND ICOT TEST RESULTS	ESULTS		Revised 12/02/93
			HLPS			ICOT		
POSF	Conc.	Carbon	ΔP	Burn Off	Blower Tube	Blower Tube Filter Carbon	Burn Off	
Number	mg/L	ug/cm2 mm Hg /	mm Hg/Min.	Date	Carbon, ug	gn	Date	Description / Supplier Recommended Dosage, mg/L
					284		Avg.	
Repeat ICOT using mass flow controller	ř.							
	100+300				41	414	5/25/93	
					9			
					16	449		
					39		Avg.	
POSF 2894 +2950	100+600	15	0 in 300	3/12/93	249		2/5/93	* Instrument malfunction
					252	328		
					251		Avg.	
Repeat ICOT using mass flow controller.								
	100+600				547	705	5/25/93	
					449	679		
					498	692	Avg.	
								The second secon
POSF 2894 + 2727 + 2904	100+300+10	22	3 in 300	3/12/93	ន	2405	2/22/93	
					27	1323		
					25	1864	Avg.	
POSF 2894+2787	100+10	17	2 in 300	3/12/93	88	37	2/5/93	
					83	203		
					88	120	Avg.	The second secon
Repeat I COT using mass flow controller.	-							
	100+10				1010	874	5/25/93	
					1220	972		
			į		1115	923	Avg.	
POSF 2894+2787+2790	100+10+100	114	6 in 300	3/12/93	118	629	2/22/93	
					256	579		

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			HLPS A	ND ICO	HLPS AND ICOT TEST RESULTS	ESULTS		Revised 12/02/93
			HLPS			ICOT		
POSF	Conc.	Carbon	ď۷	Burn Off	Blower Tube	Blower Tube Filter Carbon	Burn Off	
Number	mg/L	ug/cm2	ug/cm2 mm Hg / Min.	Date	Carbon, ug	δn	Date	Description / Supplier Recommended Dosage, mg/L
					187	619	Avg.	
POSF 2894+ 2727 + 2904 + 2856								
	100+300+10+25	89	5 in 300	3/12/93	41	1052	2/22/93	
					42	1404		
					42	1228	Avg.	
Exper. Conc. Blends from Betz Chemical	nical							
70% POSF 2894 + 30% 2787	100	46	4 in 300	4/2/93	107	1221	5/24/93	
					629	1591		
					٤	1409	Avg.	
70% 2894+20% 2787+10% 2790	100	17	96 in 300	4/2/93	869	1367	5/24/93	
					843	1375		
					856	1371	Avg.	
Affect of DuPont 2786 in Reference Fuels	nels.							
		1					00,000	
POSF 2827 36( A-1 Ref. Fuel + 2780	=	26	000 110	76/07/0	362	1070	SEINZIG	
					862	1126	Avg.	STATE OF THE PROPERTY OF THE P
POSF 2926 + 2786	=	36	0 in 300	4/26/93	5240	2550	6/8/93	
					3490	1290		
					4365	1920	Avg.	The state of the s
							-	
POSF 2928 + 2786	11	23	0 ln 300	4/26/93	5520	2510	6/8/93	

APPENDIX A: APPA\_FIN.XLS

			HLPS A	ND ICO	HLPS AND ICOT TEST RESULTS	<b>ESULTS</b>		Revised 12/02/93
			HLPS			ICOT		
POSF	Conc.	Carbon	ΔP	Burn Off	Blower Tube Filter Carbon	Filter Carbon	Burn Off	
Number	mg/L	ug/cm2	mm Hg/Min.	Date	Carbon, ug	ng	Date	Description / Supplier Recommended Dosage, mg/L
					5280	2850		
					5400	2680	Avg.	
POSF 2922 + 2786	=	8	0 in 300	4/26/93	4720	13400	6/11/93	
					2990	15600		
					3855	14500	Avg.	
POSF 2934 + 2786	=				699	2230	6/11/93	
					622	1400		
					724	1815	Avç.	
POSF 2936 + 2786	=	29	0 in 300	4/26/93	737	1850	6/3/93	
					866	1830		
					802	1840	Avg.	
POSF 2959 + 2786	11	8	0 in 300	4/26/93	378	279	6/11/93	
					388	303		
					383	291	Avg.	
Affect of POSF 2894 in Reference Fuels	ls.							
POSF 2827 Jet A-1 Ref. Fuel + 2894	100	16	2 in 300	Average	1660	1320	1/13/93	
					2110	942		
					0001	1611	W.	
POSF 2926 + 2894	\$	25	0 in 300	4/14/93	8570	1350	6/8/93	
					7520	1620		
					8045	1485	Avg.	
POSF 2928 + 2894	100	23	00E uj 0	4/14/93	5420	2350	6/8/93	
					9120	1820		
					7270	2085	Avg	

APPENDIX A: APPA\_FIN.XLS

			HLPS AI	VD ICO	AND ICOT TEST RESULTS	<b>ESULTS</b>		Revised 12/02/93
			HLPS			ICOT		
POSF	Conc.	Carbon	ΔP	Burn Off	Blower Tube	Filter Carbon	Burn Off	
Number	mg/L	ug/cm2	mm Hg/Min.	Date	Carbon, ug	Б'n	Date	Description / Supplier Recommended Dosage, mg/L
POSF 2922 + 2894	100	14	0 in 300	4/14/93	4140	13800	6/11/93	
					5920	2830		
					5030		Avg.	
POSF 2934 + 2894	100	180	1 in 300	6/16/93	93	2640	6/11/93	
					6050	2040		
						2340	Avg.	
POSF 2936 + 2894	100	32	0 tn 300	4/20/93	3140	3550	6/3/93	
					2770	3250		
					2955	3400	Avg.	
POSF 2959 + 2894	100	30	0 in 300	4/20/93	956	301	6/11/93	
					709	276		
					833	588	Avg.	
AFFECT OF JP8+100 CANDIDATE ADDITIVES ON POSF 2827 JET A-1 REF. FUEL	DITIVES ON	OSF 282	7 JET A-1 RE	F. FUEL				
CONTAINING ALL REQUIRED AND O	PTIONAL MIL	. SPEC. A	DDITIVES (N	SA)*.				
POSF 2827+MSA*								
POSF 2827+ MSA + 2894	8							
POSF 2827+MSA+ 2894+ 2843	100+25							
* MSA package components used for these tests:	r these tests:							
Antioxidant (POSF 2851), 24 mg/L.								
Antistatic (DuPont Stadis 450), 150 to 600 pS/m.	00 pS/m.							
Corrosion Inhibitor (DuPont DCI 4A), 24 ppm	ppm.							

APPENDIX A: APPA\_FIN.XLS

			HLPS A	ND ICO	S AND ICOT TEST RESULTS	ESULTS		Revised 12/02/93
			HLPS			ICOT		
POSF	Conc.	Carbon	ΔP	Burn Off	Blower Tube	Fifter Carbon	Burn Off	
Number	mg/L	Ĭ	mm Hg / Min.	Date	Carbon, ug	бn	Date	Description / Supplier Recommended Dosage, mg/L
Fuel System Icing Inhibitor (Diethylene glycol monomethyl ether), 0.15 volume %	col monome	thyl ether),	0.15 volume	%.				
SPECIAL INVESTIGATIONS								
POSF-2893, (WL 1/92)		9	300 in 285	2/21/92				
		4	4 in 300	3/27/92				
POSF-2827 + Stressed Super K-1: TAN of 0.015	10.015	22	300 in 180	7/1/92				
POSF-2827 + Stressed Super K-1: TAN of 0.03	of 0.03	75	300 in 180	7/1/92				
HLPS 17-MICRON FILTER EXPERIMENT	17							
POSF 2881 + 2913	25+5	21	23 in 300	8/4/92				The 17 micron filter from test #1 was cleaned with trisolvent,
	25+5	01	300 in 1	8/4/92				vacuum flushed in reverse direction to fuel flow and dried
								prior to use in test #2.
MISC. NOTES:								
1. Candidate additive inventory now numbers 162.	bers 162.							
2. JP-TS is a blend of:								
Isopar H								
Varsol 1 (soddard solvent or mineral spirits), IBP 159C; EP 202C	s), IBP 159C	EP 202C						
LOPS (low odor parafinic solvent) aka Turbo Fuel A	bo Fuel A							
3 Additive incompatibility:								
	solution: ov	er night dro	ps out of solu	tion. Hazy s	wirls.			
POSF 2855 plugged filter 2 hours into test.	est.							
POSF 2866 Unable to get into solution after heating at 120°F and stirring over night.	after heating	at 120°F a	nd stirring over	er night.				
POSF 2876 blocked fuel line 1 hour into test.	o test.							
POSF 2881 rapid delta P Increase. Variable delta P with 2913 & 2912	riable delta P	with 2913		oluble precip	ate when blen	Insoluble precipate when blended with 2759 and 2899	and 2899.	

		M	TP Tes	sts						Revise	d 03/2	6/92
										All Data	From A	VI Test
POSF		Conc.		Test		50 mL S	amples	, μg carb	on	Filter	1	std
No.	Description	(mg/L)	Date	No.	1	2	3	4	5	Avg.	Avg.	dev.
JP-TS	10 mg/L 2904 +	0	7/24/91	1	1571	1619	1638	1796	1896	1704		
Exxon	23 mg/L 2851 +		8/02/91	2	3632	3670	3755	4109	3790	3791		
	11 mg/l 2786			3	2947	2962	3057	2927	2908	2960	2818	897
				4	2799	2790	3001			2863	Not Pre	filtered
				ļ								
91-2795	Upper Limit	0	8/09/91	1	3135	2847	2480	3354	3370	3037		
		-	8/09/91	2	3792	3676	3968	3761	4116	3863	3450	516
90-2747	Highly Refined	0	8/12/91	1	3133	2918	3119	2000	2070	2007		
50-2141	nighiy nehheu	<del>  "</del>	8/14/91	2	5629	5865		2888 5698	2879 6463	2987 5888	4438	1547
<del></del>		<del></del>	0/14/91			3003	3/00	2090	0403	7000	4438	1547
				3	4874							_
· · · · · · ·											<u> </u>	-
	N2 Over Pressure	0	9/06/91	1	374	357	344	340		354		
	No Over Pressure	0	9/20/91	1	706	694	709	730	824	733		
90-2786	SOA	11	7/24/91	1		8774	8363	7149	7258	7886		
			8/02/91	2	8827	9236	9943	8800	8996	9160		
			8/12/91	3	7336	7405	7156	7220	7378	7299	8132	956
	•											
	SOA	50	9/20/91	1	9443	8983	8441	10070	9332	9254		
		100	9/24/91	1	8375	7725	5894	6155	6091	6848		
90-2748	Extender/Stabilizer	200		1	10610	10840				10725	Not Pre	filtorod
30-21-40	LAGE IGE / GLADIIZE	200		<del>  '</del> -	10010	10040				10723	NOLFIE	IIIIGIGU
90-2753	N2/O2 Type AO	25		1	7520	9012				8153	Not Pre	filtered
	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,									7.00		
90-2761	N2 AO	25	7/25/91	1	7248	6077	5147	4539	4483	5499		
				2	6304	5977	5327	4750	4716	5415	<del></del>	915
				3	6774	5838	6500			6371	Not Pre	filtered
00.0700	D-A/Distr	1000				2422	1222				<u>i                                     </u>	
90-2726	Det./Disp.	1000	<del> </del>	1	8773	6190	4930	5098	15170	Formed S	ludge	
90-2776	AO/Det./Disp./	12		1	8382	9227				8805	Not Pre	filtered
00 2.70	7.0700tDiop		<u>†                                      </u>	<u> </u>		- OLL!				5555	1101110	into: oa
91-2827	Additive Free	0	7/23/91	1	8957	8334	7276	7225	7408	7840		
				2	7004	6643	6200	6107	6466	6484	7162	912
				3	7474	6968				7221	Not Pre	filtered
										[		
	N2 Over Pressure	0	9/06/91	1	748	718	762			743		ļ
	44-05			<del> </del>							-	ļ
<del></del>	No Over Pressure	0	9/23/91	1	372	347	462	350	361	378	-	<del> </del>
00.077	40/D: 4:D			ļ		40000				4225		
90-2774	AO/Disp./MD	12		1_	9838	10260				10049	Not Pre	nitered
90-2744	Det./Disp.	1000	-	1	14000	13720				12000	Not Pre	fileared
30-2144	Det./Disp.	1000	<del> </del>	<del>                                     </del>	14000	13/20				13000	INUL PIE	Determin
NI-A		+	-			<u> </u>				-	<del></del>	+
Notes:	L			Щ	L	L		L		<u> </u>	-	
	t Conditions: Prefiltered			-0/0 115				A -: 1			i	1

	FUEL RE	ACTO	IN IESIS	<u> </u>			Revise	d 4/14	V92
POSF		Conc.	BURN OFF	Test	Carbon	Avg. of			r
No.	Description	(mg/L)	Date	No.	ug	Runs	Range	sd	(sd/x
91-2799	Upper Limit	0	12/6/91		242		ļ		
			12/6/91	2	216	229	26	18	
		-	4/9/92	3	155		ļ		
		-	4/9/92	4	164	160	9	6	·
04 0007	A della company		10/001		545		-		
91-2827	Additive Free	0	12/6/91	1	545				
			12/16/91	3	433				
····		<del> </del>	12/16/91	4	553	501	100	50	
· · · · · · · · · · · · · · · · · · ·		<del> </del>	4/9/92	5	474	501	120	58	
		<b>-</b>	<del> </del>	6	562	EEC		_	
			4/9/92		570	566	8	6	
2786in 2747		11	1/16/92	1	250				
			1/16/92	2	242				
			1/16/92	3	258				
			1/16/92	4	242	248	16	8	· · · · · ·
90-2747	Highly Processed	0	1/16/92	1	260				
			1/16/92	2	278				
			1/16/92	3	285				
			1/16/92	4	252	269	33	15	
			4/9/92	5	181				
			4/9/92	6	168	175	13	9	
90-2761	N2 Type AO	25	2/7/92	1	496				
			2/7/92	2	398	447	98	69	_
			2/7/92	3	551				
			2/7/92	4	483	517	68	48	
					ļ		ļ		
90-2786	SOA	11	2/7/92	1	783		ļ		
	ļ		2/7/92	2	493		ļ		
			2/7/92	3	453		ļ	ļ	
		<u> </u>	2/7/92	4	441	543	342	162	
			4/9/92	5	787				
			4/9/92	6	815	801	28	20	
91-2841	N2/O2 AO	25	3/4/92	1	223				
			3/4/92	4	373	298	150	106	
91-9843	O2 AO	25	3/4/92	3	192				
			3/4/92	4	167	180	25	18	
		1	1		1		1		

	FUEL RE	ACTO	R TEST	S			Revise	ed 4/14	1/92
POSF		Conc.	BURN OFF	Test	Carbon	Avg. of			r
No.	Description	(mg/L)	Date	No.	ug	Runs	Range	şd	(sd/x)
90-2774	AO/Disp/MD	25	3/4/92	2	234		<b></b>		<del></del>
		<u> </u>	3/4/92	3	274	254	40	28	
91-2881	N2 AO	25	3/4/92	1	486				
			3/4/92	2	250	368	236	167	
2. 36	AO/Dispersant	25/11	4/2/92	1	279	<del></del>			<del></del>
			4/2/92	2	229	254	50	35	
			4/9/92	3	269				
			4/9/92	4	296	283	27	19	
2881+2786	AO/Dispersant	25/11	4/2/92	1	325		<b>-</b>		<del></del>
			4/2/92	2	283	304	42	30	
91-2385	N2 AO		4/9/92	1	429				
			4/9/92	2	280	354	149	105	
91-2872	N2/O2 AO		4/9/92	1	348				
			4/9/92	2	343	345	5	4	
·		<del> </del>					<del> </del>		ļ
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							<b></b>		
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							<u> </u>	-	